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THIRTY-SEVENTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

BOARD OF AGRICULTURE,

TOGETHER WITH THE

SEVENTH ANNUAL REPORT
OF THE STATE EXPERIMENT STATION.

1889.

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Office of the Secretary, Commonwealth Building, Boston.

THE THIRTY-SEVENTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The past year has been a peculiar one in the experience of the agriculturists of the Commonwealth. The winter of 1888–89 was unusually mild. The ice harvest was thereby delayed until February, and less than the usual amount was secured. Most of the farmers were enabled to obtain the amount necessary for dairy purposes. The co-operative creameries also secured nearly a full supply.

The mild weather of the winter enabled farmers to winter their stock more cheaply than usual. It is doubtful, however, whether, on the whole, such a season is to be preferred even for stock-feeding. The bracing weather of a normal New England winter is not unhealthful for animals that are well protected, and the small amount saved in feed it is believed is more than balanced by the reduced energy caused by unseasonably mild weather. The lack of snow also prevented farmers from accomplishing much of the work for which the winter is usually most favorable. Less wood was prepared for market, and lumbering and the hauling of railroad ties was carried on under peculiar difficulties. While this kind of work is not strictly agricultural, it is depended upon by many Massachusetts farmers to help out the year's income. Most of them own, in connection with their farming land, a larger or smaller amount of woodland, which can only be made of use to them by giving employment to men and teams in the winter months, when farming operations must be at a standstill. The loss to the farmers in this direction caused by the mild winter of 1888–89 was severely felt. The present winter has been of like character, and the inconvenience and loss of the last season are likely to be duplicated. The large number of rainy and cloudy days the past summer and autumn caused our pastures to produce bountifully. As a consequence, our dairies furnished an unusual amount of milk and butter during the summer and early autumn, depressing the price of these products to an unusual extent. More milk was furnished the milk contractors than the market would take, and they were obliged to make unusually large amounts of butter. This butter, with the increased amounts made by the farmers and co-operative creameries, together with the large amounts from outside the State, over-loaded the market; and, as a consequence, large quantities were put into cold storage, where they remained for sale at low prices, keeping the fall and winter prices below what they have been in former years. Oleomargarine has also been put upon the market in larger quantities than ever before. This state of things is not particularly encouraging to the dairymen of the State. Still, our farmers must make milk and butter; for, while those whose farms are in favorable locations can profitably raise market-garden products and small fruits, those living in more retired locations must depend on the returns from dairy stock. Sheep-keeping would be profitable, were it not for the increasing ravages of the dogs. The assessors' returns of May last show an increase of 4,313 in the number of cows, and a decrease in the number of sheep of 2,920. It appears to be only a question of time when sheep will only be kept on the farms of those who can afford to guard them from the ravages of dogs by shepherds. The encouraging feature of the dairy business is the fact that the fertilizers necessary to keep up the fertility of the soil are furnished as a waste product. Experiments of chemists show that the excrements of a well-fed cow in twelve months contain nitrogen, phosphoric acid and potash, worth, at the market price of those articles, more than forty-five dollars. This sum is no mean addition to the value of the milk and butter product of the cow. These elements are absolutely necessary to replace what our crops take from the soil, and should be counted as part of the income of the business. But, to realize their value, the utmost care should be exerted to save the whole, and apply them to the soil in the manner to secure the best possible results. Agriculture has come to be as close a business as manufacturing, and the same shrewdness, energy and industry that achieve success in other callings are necessary to make any branch of agriculture profitable.

The number of co-operative creameries in the State has been increased during the year by the establishment of four new ones, — in Ashfield, Belchertown, Worcester and Three Rivers. One, the Richmond, has been burned and not yet rebuilt. There are now twenty-eight in active operation, with several more in process of organization.

I have found great difficulty in getting returns from some of the creameries. Some of the officers seem to have an idea that our inquiries are inquisitorial, and for some sinister purpose. I desire to assure not only the creamery companies but all organizations and individuals, that the Board of Agriculture and their Secretary have no wish to use information to their injury, and only desire to help on all honorable schemes for the benefit of Massachusetts agriculture.

The following table will give a general idea of the condition and work of the co-operative creameries the past year: —

Statistics of Creameries in Massachusetts for the Year 1889.

NAME.	Location.	Date of Incorporation.	Treasurer.	Pounds of Butter made.	Average Price Received per Pound.	Average Price per Pound net Realized by Patrons.	Number of Cows Supplying Cream.	Spaces of Cream Supplied.	Number of Patrons.
					Cents.	*Cents.*			
Amherst Co-operative Creamery Association, The	Amherst,	June 23, 1882,	William A. Magill,	232,120	-	-	-	1,460,173	-
Ashby Creamery Association,	Ashby,	-	F. W. Wright,	36,000	26.1	21.2	-	241,622	30
Bay State Co-operative Creamery Association, The,	East Amherst,	Jan. 8, 1889,	-	-	-	-	-	-	-
Berkshire Creamery Co-operative Association,	New Boston,	Dec. 5, 1886,	O. B. Jones,	86,601	24.43	18.56	500	535,300	58
Berkshire Hills Co-operative Creamery Association,	Monterey,	March 1, 1887,	H. W. Langdon,	54,190	22.63	16.97	325	351,367	30
Conway Co-operative Creamery of Conway,	Conway,	May 25, 1886,	H. W. Billings,	323,918	26.10	21.695	-	2,033,870	[1]150
Cummington Co-operative Creamery Association, The,	Cummington,	July 8, 1886,	R. R. Packard,	151,350	23.33	20.00	800	930,699	93
Egremont Co-operative Creamery Company, The,	North Egremont,	April 27, 1886,	J. A. Kline,	101,279	[1]22.50	19.30	[2]700	672,613	42
Granby Co-operative Creamery Association, The,	Granby,	Jan. 21, 1889,	W. S. Clark,	[3]50,174	25.90	20.60	260	312,323	29
Hampton Co-operative Creamery Association,	Easthampton,	July 6, 1881,	J. A. Lyman,	107,265½	24.50	20.70	450	661,692	59
Hinsdale Co-operative Creamery Association,	Hinsdale,	July 31, 1886,	F. B. Cook,	113,968	[1]25.50	[1]20.00	[1]900	734,004	75
Ipswich Co-operative Creamery Company, The,	Ipswich,	April 24, 1885,	Curtis Damon,	92,677	29.23	24.12	550	603,728	57
Lee Creamery Co-operative Association, The,	Lee,	Nov. 10, 1881,	David Dresser,	39,164	23.06	16.5	[4]200	-	30
North Brookfield Co-operative Creamery Association,	North Brookfield,	March 17, 1885,	H. E. Cummings,	109,908	25.70	20.42	600	741,218	60
Northfield Co-operative Creamery Association,	Northfield,	April 16, 1885,	L. T. Webster,	139,213	25.68	21.37	769	859,313	89
Northampton Creamery Company Co-operative,	Northampton,	May 16, 1887,	M. T. Mason,	252,594	26.00	21.75	-	1,631,861	100
Phillipston Co-operative Creamery Company, The,	Phillipston,	Feb. 24, 1888,	-	-	-	-	-	-	-
Rutland Co-operative Creamery Association, The,	Rutland,	April 16, 1886,	L. T. Hadley,	81,124	27.00	22.00	-	577,213	60
Shelburne Falls Co-operative Creamery Association,	Shelburne Falls,	Nov. 19, 1885,	-	-	-	-	-	-	-
Singletary Co-operative Creamery Association, The,	Millbury,	April 28, 1887,	C. N. Woodbury,	41,666	28.00	22.00	200	262,445	30
Springfield Mountains Co-operative Creamery Assoc'n,	Hampden,	Nov. 21, 1887,	C. H. Burleigh,	72,813	26.52	21.64	310	458,964	32
Wellesley Co-operative Creamery Association,	Wellesley Hills,	May 17, 1887,	Edward Lyon,	19,859¾	29+	21.22	125	155,745	19
West Dudley Co-operative Creamery Association,	West Dudley,	Jan. 11, 1885,	H. W. Williams,	54,843	26.75	20.92	235	365,448	30
Worcester County,	Warren,	-	O. E. Parker,	33,256	24.63	19.63	-	216,286	21

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[1] About.

[2] Entire number.

[3] Began business March 4.

[4] Part of the time.

In addition, the Lowell Co-operative Milk Association made 49,674 pounds of butter; average price received per pound, 29 cents; number of cans of milk received, 210,000. Also the Springfield Co-operative Milk Association made about 83,950 pounds of butter; average wholesale price received per pound, 27 cents; average retail price, 32 cents; number of quarts of milk received, 2,263,750. Average price per quart realized by patrons was three cents.

The farmers' institutes, which the rules of the Board require each agricultural society to hold, have been usually well attended. Members of the Board have labored assiduously to make these institutes a success. It is believed that much has been accomplished in spreading valuable information among the farmers. Not less than one hundred and twenty have been held. At least one lecture has been furnished by a member of the Board or by an expert not a member, at each institute. The funds necessary to meet the expenses of these lectures have been furnished from an appropriation by the Legislature for the dissemination of useful information in agriculture. Chapter 20, section 10, of the Public Statutes, empowers the Secretary of the Board of Agriculture to appoint agents to visit the towns of the State, to gain information, encourage the formation of farmers' clubs, and to disseminate information by means of lectures or otherwise. The Legislature of 1888 was asked for an appropriation to carry out the intent of this section. The sum of one thousand dollars was appropriated for this purpose, and in 1889 twelve hundred dollars was in like manner placed at the disposal of the Secretary. In addition to the sum paid for lectures, the printing of a special bulletin, giving information of the habits and characteristics of the gypsy moth, a new and dangerous enemy to agriculture and horticulture, was paid for from this fund, and distributed throughout the State by the Hatch Experiment Station. The expense of the crop report issued monthly during the summer and fall of the last two seasons was also paid from this fund. The usefulness of this publication in a State situated like Massachusetts cannot be as great as a report that would take in the whole country, because much of the supply of Massachusetts markets comes from outside the State. But it is hoped that this may be a hint to the other States to do likewise. With such a crop report from each State, the whole might be collated, and very valuable information as to the probable supply of the various agricultural products thus be obtained. These crop reports have been prepared each month by F. H. Fowler, clerk in this office, whose valuable assistance in all the labors of the Secretary is hereby acknowledged. It is believed that a synopsis of the several reports of the past season prepared by him would be interesting as a matter of record, and they are here inserted.

Synopsis of Crop Reports.

Early in the spring of 1888 the idea of circulating information concerning the condition of our principal farm crops during the growing season was entertained, and, after consultation with the executive committee, it was decided to try the experiment. It was presumed that the required information could be most readily obtained through the medium of the farmers' clubs and granges. Accordingly a circular was prepared and sent to each of these organizations, stating the proposed plan, and asking each to appoint some one to act as our correspondent. In localities where there was no such organization, parties whom it was thought would be willing to serve were selected, in order that the State might be thoroughly covered. The plan was to send blank circulars, modelled after those used by the United States Department of Agriculture, to correspondents about the 20th of each month, said blanks to be filled out and returned to us on the first day of the month following. These returns when received were to be compiled into a crop report or bulletin, and mailed as soon as practicable to such parties as it was thought would appreciate them. The first blank was sent out about the 20th of June, and the first bulletin, consisting of thirteen printed pages, made up of general remarks, remarks on the weather, remarks on the condition of principal crops, notes of correspondents, and a table giving the acreage and condition of principal crops by counties, was issued about the 7th of July following. Similar bulletins were issued for the months of July, August, September and October. Six hundred copies of the first bulletin were printed, but before the close of the season it was found necessary to increase the number to one thousand. The experiment met with such an appreciative reception that it was decided to continue the work another year. Consequently, on the opening of the past season, arrangements were made for the continuation of said work, and it was decided to enlarge its scope and usefulness by increasing the size of the bulletins to twenty-four pages; by giving more attention to the weather, for which purpose a synopsis of the monthly reports of the Meteorological Observatory of the Hatch Experiment Station at Amherst were to be added; by making the notes of correspondents fuller; and by devoting the last three or four pages of each bulletin to extracts upon various agricultural subjects. After the first two bulletins, it was found necessary to increase the size of the edition to twelve hundred copies. The following synopses will illustrate the character of the work: —

Synopsis of Bulletin No. 1. — Crop Report for May.

The first half of the month was warm and dry. Rain set in on the morning of the 20th, and fell almost every day during the remainder of the month. Slight frosts were reported as occurring on the mornings of the 27th, 28th, and 29th, but scarcely any damage was done. In the circular sent to correspondents about the 20th of the month, the following questions were asked: "1. How much earlier is this season than the last? 2. What insects are doing the most damage in your vicinity? 3. Is good help plenty, and at what cost? 4. What is the outlook in your section?" About one hundred returns were received, showing that the season opened favorably for the farmer, and that it averaged two weeks earlier than last, although the cold wet weather the last of the month tended to overcome the unusual earliness of the season. The tent-caterpillar (*Clisiocampa Americana*) was reported as being unusually prevalent in many sections, and a short sketch from Mrs. Mary Treat's work on "Injurious Insects of the Farm and Garden" was printed, to describe its work and to suggest methods of extermination. The cranberry-vine worms, cut worms, Colorado potato beetles, squash bugs, cabbage maggots, currant worms, canker worms, onion maggots, asparagus beetles and curculios were also reported as doing more or less damage in localities where they would naturally be found. Good farm help appeared to be rather scarce in many localities, and commanded, on an average, from twenty to twenty-two dollars per month and board. The general outlook was reported as good. There was promise of a large hay crop, although dry weather the fore part of the month checked the growth of grass in some places. However, this dry weather was very favorable for planting, and seeds came up well. Wet, cold weather the last of the month, while it greatly helped grass, had a bad effect on corn.

In this report was included an article upon "Agriculture in Massachusetts," by H. G. Wadlin, chief of the Bureau of Statistics of Labor.

Synopsis of Bulletin No. 2. — Crop Report for June.

In the circular sent to our correspondents about the 20th of the month, the following questions were asked: "1. What insects are doing the most damage in your vicinity? 2. What date did haying commence in your vicinity? 3. Is the hay crop up to last year's crop in quantity and quality? 4. Is the outlook as favorable as it was June 1? 5. What is the prospect for an apple crop?" About ninety-five returns were received, indicating that about the same insects as were reported last month were still at work. To that list might also be added rose bugs and the "spittle insects" on grass. Haying commenced, on an average, about June 20; but, owing to unfavorable weather, the work of securing it was not pushed as rapidly as the condition of the grass would warrant. In some sections haying commenced as early as the first week in June, while in others, especially on the western hills, it did not commence much before July 1. About one-fourth of the crop had been secured by the close of the month, and it averaged well with last year's crop. In quantity it was rather more, but in quality rather below, owing to so much wet, cloudy weather. As a whole, the outlook was as favorable as it was June 1. The apple crop promised to be below an average. In some sections it was the off year, and in such the crop would be very small. Many trees set full, but the young apples dropped off badly. The strawberry crop was below an average, both in quantity and quality. Corn, though backward on account of the wet weather, pushed rapidly ahead during the last week. Potatoes promised well. There was some complaint of blast on the vines; but, on the whole, a good crop might be expected. In general, all crops were growing finely, and promised good harvests.

In this report was included a letter by John G. Whittier to the Essex Agricultural Society.

Synopsis of Bulletin No. 3. — Crop Report for July.

The month of July was marked by frequent rains and much cloudy weather. A severe thunder storm, accompanied by hail, passed over the eastern portion of the State on the afternoon of the 17th, doing much damage to crops. On the 23d another heavy thunder shower passed over Essex County, also doing much damage to crops. In Boston, with two exceptions, it was the wettest July for nineteen years, and, with three exceptions, the coolest July for the same length of time. In the circular sent to correspondents about the 20th of the month, the following questions were asked: "1. What is the outlook for a corn crop? 2. Have small fruits been satisfactory in yield and price? 3. Have you observed any rot or scab in potatoes? 4. Has the hay crop met your expectations in quantity and quality? 5. What is the prospect for a crop of early market apples?" About ninety-five returns were received, from which we learned that the outlook for a corn crop was generally good. Owing to so much rain, it was late; but warm, pleasant weather would insure a good crop. Small fruits were generally satisfactory in price, but not in yield. The hay crop met expectations in quantity, but not in quality. During the month there were very few good hay days, and much hay was damaged. At the close of the month considerable grass remained to be cut. Where grass was cut early, a large crop of rowen was promised. Continuous rains caused streams to swell, and low lands were so flooded in many sections as to render the gathering of hay from them almost an impossibility. Potato vines blasted badly in many sections; rot and scab followed the blast; and it was predicted that in all probability the potato crop would be much below an average in quantity and quality. Many fields were already badly injured. The prospect for a crop of early market apples was only fair at best, and in many sections the yield promised to be slight. The excess of rain caused weeds to make a heavy growth, and made the cultivation of crops difficult and costly. Oats rusted badly.

In this report was included a paper upon "The Law of Trespass, and how it affects the Farmer," by B. W. Potter, Esq., of Worcester.

Synopsis of Bulletin No. 4. — Crop Report for August.

The first half of the month was marked by cloudy, muggy weather, with occasional light rains. The last half was warm and dry. This warm, dry weather, following so long a period of wet weather, caused vegetation of all kinds to mature rapidly, and everything to put on a fall-like appearance. The rainfall for the month was rather below the average. There was a slight frost at Chester on the 29th, and at Templeton, on low land not protected by fog, on the 28th and 29th. In the circular sent to correspondents about the 20th of the month, the following questions were asked: "1. What is the prospect for winter apples in quantity and quality? 2. Is the acreage of meadow land reseeded in the fall increasing in your locality? 3. What is the prospect for late potatoes, and have you observed rot or scab? 4. Is the amount of corn grown for ensilage purposes increasing in your locality?" About ninety returns were received, from which we learned that there would be about half a crop of winter apples, of rather poor quality. On the whole, the acreage of meadow land reseeded in the fall was reported as increasing. The wet weather of July and the early part of this month caused potato vines to blast badly. Rot quickly followed, and it was predicted that there would not be over half a crop of potatoes. Those that were nearly ripe when the blast struck them were good, and rotted but little. Those planted late and only about half matured when the blast came were almost a total failure. Many fields were not worth digging. The warm, dry weather of the last two weeks had a tendency to keep the rot from spreading. Scab has also been prevalent this season. The amount of corn grown for ensilage purposes appeared to be increasing in most localities. The Southern white variety seemed to be the one most generally preferred. Celery rusted badly in some sections. The corn crop promised to be a good one. In some sections blight had struck the corn fields, and some of them were reported as almost worthless. Corn cutting had commenced, although most of the crop needed fully a week of warm, dry weather. The tobacco crop was in general a very good one, and was harvested in excellent condition; some damage was done to the crop by rust and fleas. On land where the first crop of grass was taken off early, the rowen crop was very large, and at the close of the month much of it had been secured in excellent shape. Pastures held out well. Fruits of all kinds were inferior both in quantity and quality.

In this report was included an extract from an address before the Housatonic Agricultural Society, by Rev. F. H. Rowley of North Adams.

Synopsis of Bulletin No. 5. — Crop Report for September.

The weather was quite generally damp and cloudy, with frequent light rains. The rainfall for the month was slightly below the average. The first week was unusually warm, while the temperature for the remainder of the month was about normal. Slight frosts occurred during the last ten days of the month, in various parts of the State, but scarcely any damage was done to crops. In some sections, high winds, the 10th and 11th, blew off considerable fruit. In the circular sent to correspondents about the 20th of the month, the following questions were asked: "1. Estimated number of baskets of peaches grown in your vicinity this season; average price per basket? 2. What is the outlook for success in the future cultivation of the peach in your locality?

3. How have the peculiarities of the season affected dairy products in quantity and price? 4. Are farmers in your vicinity generally interested in agricultural fairs?" About eighty-five returns were received, reporting a total estimate of twenty-five hundred baskets as the peach crop this season, and $1.85 as the average price per basket. It is evident that the total yield must have been considerably larger. From these returns we also learned that, while many towns produced a few peaches, very few farmers gave much attention to the growing of this fruit. Most of our correspondents report that the outlook for success in the future cultivation of the peach is not very encouraging. The peculiarities of the season caused, in some localities, an increase in the quantity of dairy products, while prices remained about an average. The excess of moisture and cloudy weather produced an inferior quality of feed, and this was followed by loss of quality in dairy products. The farmers of the State, as a whole, are undoubtedly interested in agricultural fairs, and receive direct benefit from them. The rowen crop was unusually large, but, owing to unfavorable weather, much of it was spoiled in trying to secure it. The average yield was about one ton per acre. The onion crop was below the average, both in quantity and quality. The cranberry crop was about three-fourths of an average. Late potatoes were about half a crop, with quality about three-fourths of an average. The crop of winter apples was somewhat less than half a crop, of about three-fourths of an average quality. By the close of the month corn had been cut and husking had commenced in some sections.

In this report was included an extract from an address before the Essex Agricultural Society, by Hon. H. G. Herrick of Lawrence.

Synopsis of Bulletin No. 6. — Crop Report for October.

The weather during the month was very much like that of the preceding months. There was less bright sunshine than usual. The rainfall was above the average. At Milton the mean temperature was nearly two degrees below the forty years' average. Snow fell in Monroe on the 8th, 11th and 13th. There were no severe gales. In the circular sent to correspondents about the 20th of the month, the following questions were asked: "1. Is this year's crop of Indian corn an average one? 2. Are root crops up to the average in quantity and quality? 3. On the whole, has this season been a profitable one for your farmers? 4. In your opinion, what per cent of farms in your town are mortgaged? 5. In your opinion, is the number of deserted farms in your vicinity greater than it was ten years ago?" About eighty returns were received, from which we learned that the crop of Indian corn was fully an average one. Root crops, other than potatoes, were just about an average in quantity and quality. As to whether the season had been a profitable one or not, seventy-seven replies were received, of which forty-four said it had, and thirty-three said it had not. The following table will give a partial idea of the extent to which farms are mortgaged: —

COUNTIES.	Number of Replies.	Less than 5 Per Cent.	5 Per Cent.	8 Per Cent.	10 Per Cent.	15 Per Cent.	20 Per Cent.	25 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	More than 50 Per Cent.
Barnstable, . .	2	2	–	–	–	–	–	–	–	–	–	–
Berkshire, . .	4	–	–	–	1	–	–	2	–	–	–	1
Bristol, . . .	2	2	–	–	–	–	–	–	–	–	–	–
Dukes, . . .	1	–	–	1	–	–	–	–	–	–	–	–
Essex, . . .	4	2	–	–	1	–	–	–	–	–	–	1
Franklin, . . .	8	–	1	–	–	–	1	3	1	–	1	1
Hampden, . .	5	1	1	–	–	–	1	2	–	–	–	–
Hampshire, . .	8	–	–	–	1	–	–	1	2	–	2	2
Middlesex, . .	8	–	–	–	2	1	1	1	–	1	2	–
Nantucket, . .	1	1	–	–	–	–	–	–	–	–	–	–
Norfolk, . . .	2	–	–	–	–	–	–	–	–	–	2	–
Plymouth, . .	7	–	3	–	1	1	–	–	1	–	–	1
Suffolk, . . .	–	–	–	–	–	–	–	–	–	–	–	–
Worcester, . .	19	1	1	–	1	2	–	1	2	3	3	5
Totals, . .	71	9	6	1	7	4	3	10	6	4	10	11

The percentage of mortgaged farms, though in many cases high, does not necessarily indicate that farming in this State is not a paying business. Some of these mortgages were no doubt placed by parties desirous of becoming farmers, but not having sufficient capital to buy the property outright. Other farms were undoubtedly mortgaged in order to raise money with which to make desirable improvements, and to carry on farming operations with greater profit. The fifth question, " In your opinion, is the number of deserted farms in your vicinity greater than it was ten years ago?" was prepared with the view of ascertaining whether deserted or abandoned farms are increasing in number. Our replies would indicate that they are not. The following table will give an idea of the number, as compared with ten years ago: —

COUNTIES.	Number of Replies.	Yes.	No.	About the Same.	Less.
Barnstable,	1	1	–	–	–
Berkshire,	4	2	1	–	1
Bristol,	2	–	2	–	–
Dukes,	1	1	–	–	–
Essex,	5	1	2	1	1
Franklin,	9	3	5	1	–
Hampden,	5	3	2	–	–
Hampshire,	8	3	5	–	–
Middlesex,	7	2	5	–	–
Nantucket,	1	–	1	–	–
Norfolk,	5	1	4	–	–
Plymouth,	6	1	4	–	1
Suffolk,	–	–	–	–	–
Worcester,	23	7	12	2	2
Totals,	77	25	43	4	5

It may be justly said that the number of deserted farms is no criterion of the prosperity of the farming community. To a certain extent the presence of deserted farms indicates an advance in agriculture. No doubt some abandoned farms in the State ought never to have been cultivated. Some farms are deserted because the land does not pay for the labor of cultivation, or because they are so isolated as to make them undesirable as homes. Improvements in farm methods and farm machinery have had their influence, and no doubt have added to the number in localities where the soil is naturally poor, or so rough as to preclude the use of farm machinery. In some cases a portion of the land belonging to a deserted farm is absorbed into the farm of a more successful neighbor, while the house, being of little value as a rent, is left unoccupied. The tendency is towards an increase in the size of farms rather than in the number, especially in districts remote from the centres of population.

In this report was included an extract from a lecture before the Massachusetts Horticultural Society, by Prof. W. O. Atwater of Middletown, Conn.

The most important facts contained in the monthly reports received from the Hatch Experiment Station are here tabulated, to show the meteorological conditions affecting agricultural operations in the western part of the State, particularly in the Connecticut valley.

[*Latitude, 42° 23′ 48.5″ N. Longitude, 72° 31′ 10″ W.*]

	May.	June.	July.	August.	September.	October.
Pressure, in inches:—						
Mean reduced to 32° F.,	29.626	29.670	29.619	29.718	29.709	29.750
Monthly Range,	0.836	0.991	0.690	0.540	0.980	0.938
Air Temperature, in degrees F.:—						
Mean,	61.4	67.7	69.5	65.5	61.9	46.5
Highest,	88	90	84	82	79	69.5
Lowest,	40	46	54	45	40	21
Monthly range,	48	44	30	37	39	43
Mean daily range,	19.7	15.9	15.2	18.1	13.4	15.4
Greatest daily range,	33	25	28	31	28	29
Humidity:—						
Mean dew point,	52.8	61.1	62.7	59.5	56.9	39.4
Mean force vapor, in inches,	.5801	.7072	.5892	.6591	.5824	.3349
Wind:—						
Prevailing direction,	N.&S.	S.	SW.	N.NE.SW.	SW.	NNE.
Total movement, in miles,	4056	4056	4032	2811	4310	4762
Greatest daily movement, in miles,	405	485	272	213	328	367
Least daily movement, in miles,	55	28	45	16	34	20
Mean daily movement, in miles,	130.8	135.8	130	91	143.6	153.6
Mean hourly velocity,	5.5	5.6	5.4	3.8	6.0	6.4
Maximum pressure per square foot, in pounds,	9	11.5	10	6.5	9.75	12.25
Precipitation, in inches,	4.71	5.01	9.09	2.72	3.17	4.58
Hours bright sunshine,	270	277	182	194	120	129
Weather:—						
Mean cloudiness on a scale of 10,	4.2	5.3	5.4	4.3	6.5	6.0
Number of clear days,	13	3	8	7	8	9
Number of fair days,	11	20	5	12	3	6
Number of cloudy days,	4	7	18	12	19	16
Total cloudiness recorded by sun thermometer, reduced to percentage,	38	38.6	59.3	53.4	66.6	59.9

Thunder and lightning occurred on the 10th, 14th and 24th of May; the 10th, 11th, 15th, 16th and 28th of June; 7th, 8th, 23d, 29th and 30th of July; 2d, 14th and 23d of August; 17th of September; and 1st of October. Frost occurred on 27th of May; 21st and 23d of September; and the 3d, 5th, 8th, 9th, 11th, 12th, 16th, 17th, 19th, 22d, 23d and 24th of October. Snow occurred on northern hills the 13th of October. Meteors were seen on the 18th of July and the 21st of October. Auroras were seen on the 21st of October. A solar halo was observed June 3, and a lunar halo on August 4.

In order to present figures relative to other sections of the Commonwealth, it has been thought best to supplement the above by the following tables made up from returns received from the Hatch Experiment Station, the Signal Office at Boston, and from amateur observers in the towns of Monroe and Leominster. Part of the information here given was incorporated in the several crop reports, and part has been obtained since: —

Rainfall.

MONTH.	Monroe.	Amherst.	Leominster.	Boston.
May, ...	3.50	4.71	4.31	4.15
June, ...	5.50	5.01	2.42	2.77
July, ...	8.25	9.09	8.03	5.80
August, ...	4.18	2.72	3.68	3.95
September, . . .	3.13	3.17	3.05	3.19
October, ...	4.13	4.58	5.39	5.31

Weather at Amherst and Boston compared.

		Clear Days.	Fair Days.	Cloudy Days.
May, . .	Amherst, . .	13	11	4
	Boston, . . .	9	14	8
June, . .	Amherst, . .	3	20	7
	Boston, . . .	4	14	12
July, . .	Amherst, . .	8	5	18
	Boston, . . .	8	13	10
August, . .	Amherst, . .	7	12	12
	Boston, . . .	17	6	8
September, .	Amherst, . .	8	3	19
	Boston, . . .	8	8	14
October, . .	Amherst, . .	9	6	16
	Boston, . . .	8	10	13

Most of the agricultural societies are in a prosperous condition. The rainy weather of September interfered with the annual exhibitions of the several societies, causing in some instances a financial loss. This is to be regretted. It is unfortunate that such organizations are obliged to plan and scheme for money making; but, as long as the expenses of the society, including care of grounds, erection and repair of buildings, printing, advertising, and all premiums above the amount of the six hundred dollars of State bounty, must be paid largely from money received from admission fees, so long must the officers plan to attract the crowd. This is not altogether a misfortune. The cattle-show day should be a holiday for the farmer, a day of recreation for his family; and, if the whole community are interested in the affair, so much the better for the agricultural part of it. The law of the State and the regulations of the Board require each society to pay in premiums for strictly agricultural purposes an amount at least equal to the amount of bounty received from the State. The expenses and the cost of holiday attractions can in no case be paid from the bounty. Detailed reports of the doings of societies are required by law to be made to the secretary of the Board.

The thirty-three incorporated societies which held fairs last fall paid $60,721.25 in premiums and gratuities; their total actual assets, as reported to this office, Dec. 1, 1889, were $783,723.64; and their total actual liabilities were $172,982.59.

One new society, the Worcester East, located at Clinton-Lancaster, has been incorporated by the Legislature of 1890.

There is room for improvement in the returns of some of the societies. In order to have the returns of value, they should all be made up on the same system. It is proposed to issue a detailed circular of instructions along with the usual blanks for returns next season, so that these variations may be prevented, and this office have a summary that shall exhibit the condition and work of each society on the same basis.

The live stock of the State is almost entirely free from contagious diseases, unless we class tuberculosis with contagious diseases. Whether it be contagious in the technical sense, or not, there can be no doubt that it is sufficiently prevalent in the dairy herds of the State to warrant not only close attention from stock owners, but grave consideration by the Board of Agriculture, the agricultural societies and the public at large. The attention that skilled veterinarians are giving to it inspires the hope that in the near future the proper methods of dealing with it may become known and be applied by the authority of law. The report of the Cattle Commissioners will be found printed in the appendix of this volume.

The Board of Agriculture have been much interested in the discussion of the proper course to be pursued in dealing with the gypsy moth, the new imported pest which last season ravaged the trees and shrubbery of Medford. The best entomological authorities are agreed that, with prompt and vigorous action, it can be stamped out, and this continent be saved from a pest worse than the Colorado potato beetle.

This can only be done by wise methods, planned and executed by men having authority of law, and having at command for the payment of expenses a sum that will surely be sufficient to accomplish the end in view. It is hoped the present Legislature will provide both the authority and the necessary funds.

Massachusetts agriculture is, on the whole, in a prosperous condition ; but it must be remembered that this is a State of cities and large towns. Within our 7,800 square miles we have now 26 cities, and at least 60 towns that have a population of between 5,000 and 15,000 inhabitants. The business of supplying these centres of population with milk, butter, eggs, fresh fruits and fine vegetables, belongs to the farmers of the State. Those who furnish the best in condition, and at the time wanted, will find a demand and remunerative prices. But with outside competition, they cannot keep the market for themselves without the most earnest effort, applying consummate ability, enthusiasm and industry, directed by a thorough knowledge of the business. Those in the remote parts of the State have not the same advantages, and there we find many discouraged farmers and some abandoned farms. Returns to this office in answer to a circular of questions lead to the conclusion that the number of such farms is not rapidly increasing at present. Still, there are many farms for sale at a low price. The States north of us have instituted measures to bring this class of real estate to the notice of the public, in the expectation that it may lead those who may have a desire for country life to purchase, and thus benefit not only present owners and would-be purchasers, but also the State at large. Many applications for information in regard to such property in this State come to this office. We have no reliable information for such inquirers, and are obliged to refer them to Vermont and New Hampshire. Massachusetts should not be behind her neighbors in any good work. Here is a field that might be worked with good results. If our Legislature would provide a small sum for the expense, and give some officer authority to collect information, we might see good fruit. Our experience, like that of our predecessors, is, that information or statistics asked for as a favor are hard to get. Authority of law is needed to get general and reliable information.

A directory of the agricultural organizations in the State is printed in the body of this volume. This is a new feature. The collection of the data cost time and patience. It will furnish reliable information often sought after, but to be found nowhere else.

The proper distribution of the fifteen thousand copies of the "Agriculture of Massachusetts" has been given careful attention. It is well known that the distribution of a little more than one-half of the number printed is provided for by law, each Senator and Representative having twenty-five copies, and five hundred copies are bound with the public documents. A certain number have always been committed to each member of the Board of Agriculture, and the secretary of each agricultural society has also received copies in proportion to the size of the society. Every farmers' club and grange that has made required returns to this office has also received a proportionate number. This plan of distribution covers most of the towns and all the cities of the State. We found, however, last season, upon investigation, that one hundred towns had no resident member of the Legislature, member of the Board of Agriculture or agricultural organization, and so were liable to be neglected in the distribution. To prevent such injustice, arrangements were made with a suitable person in each of these towns to receive and distribute a number of copies. By these several channels copies of the "Agriculture of Massachusetts" were sent for distribution into each city and town in the Commonwealth, in numbers as nearly as possible in proportion to the farming population. The following table is here inserted, to show the distribution of the last report, so far as the same was under the control of the Secretary. The reports sent outside of the State were sent in response to requests which are continually coming to this office : —

Members of Board of Agriculture,	512
Incorporated agricultural societies,	1,350
Farmers' clubs,	1,183
Granges,	1,850
Towns, as above,	1,030
Given out at office of Secretary,	980
On hand and unaccounted for,	452
	7,357

Distribution by States and Territories: Maine, 28; New Hampshire, 15; Vermont, 17; Massachusetts, 14,326 (includes by law as above); Rhode Island, 10; Connecticut, 29; New York, 20; New Jersey, 6; Pennsylvania, 10; Delaware, 1; Maryland, 1; Virginia, 5; West Virginia, 1; North Carolina, 1; South Carolina, 2; Georgia, 5; Florida, 1; Alabama, 1; Mississippi, 1; Louisiana, 2; Texas, 1; Oregon, 3; Indiana, 4; Illinois, 4; Kentucky, 2; Michigan, 4; Missouri, 3; Arkansas, 1; Iowa, 2; Kansas, 2; Nebraska, 4; Montana, 1; Tennessee, 3; Minnesota, 5; Wisconsin, 2; North Dakota, 1; Oregon, 2; Dakota, 1; Arizona, 1; Colorado, 1; California, 2; District of Columbia, 3. Distribution to foreign countries: England, 1; Japan, 3; Canada, 4; France, 1; India, 1; Australia, 1; Italy, 2; Portugal, 1.

Additions to the library in this office are made as the funds available for that purpose seem to warrant. About one hundred volumes were added the past year.

The public winter meeting of the Board at Fitchburg the first week in December was unusually successful. A larger number attended these meetings, except the evening sessions, than have been present for several years past. The lectures were by men of more than local reputation. The subjects were vital ones to Massachusetts farmers, and were followed by intelligent and earnest discussion.

The annual meeting of the Board, February 4, 5 and 6, was attended by nearly every member of the Board. The essays presented were upon important topics, were ably written and were well received.

The death during the past year of two of our oldest and most valued members, Avery P. Slade and Dr. James P. Lynde, was noticed by suitable resolutions, which will be found printed with the records of the annual meeting.

In accordance with an act of the Legislature, the report of the State Experiment Station is bound with the report of the secretary of the Board of Agriculture. This report is increasing in size from year to year, and consequently increases the size of the "Agriculture of Massachusetts." This volume should include all annual publications authorized by State authority which pertain to agriculture. The report of the trustees of the Agricultural College and the report of the Hatch Experiment Station are of interest to the agriculturists of the Commonwealth, and are as worthy a place in the annual volume as are the report of the Cattle Commissioners and the report of the State Experiment Station. It is inexpedient to include all in one volume, and I would recommend to the Legislature that the statutes be so amended as to authorize including all these reports with the report of the secretary of the Board of Agriculture, and that the whole be bound in two volumes.

In view of the fact that the value of agricultural literature to the farmers depends largely upon its coming to hand during the winter season of leisure, I desire to suggest to the Legislature and the Board of Agriculture, the propriety of changing the time of the annual meeting of the Board from the first week in February to a date early in January. This change would enable the secretary to issue his report from two to three weeks earlier in the season than is now possible.

WILLIAM R. SESSIONS,
Secretary of the State Board of Agriculture.

BOSTON, February, 1890.

PUBLIC MEETING OF THE BOARD

AT

FITCHBURG.

PUBLIC MEETING OF THE BOARD
AT FITCHBURG.

The regular winter meeting of the Massachusetts Board of Agriculture was held at the City Hall in Fitchburg, on Tuesday, Wednesday and Thursday, Dec. 3, 4 and 5, 1889. The weather on the morning of the 3d was not such as to tempt people from their homes, as snow was falling; but the attendance during the day was exceptionally large, and the audience manifested a very intelligent and lively interest in all the proceedings.

The meeting was called to order at ten o'clock by Secretary Sessions, who introduced Mr. George Cruickshanks of Fitchburg as the gentleman selected by the committee of arrangements to preside.

The Chairman. It is fitting that we should follow the custom which has prevailed for several years at the commencement of these meetings, and I will therefore invite the Rev. Frank Rector of Fitchburg to offer prayer.

The divine blessing and guidance having been invoked, the Chairman said: —

At the last annual meeting of the Worcester North Agricultural Society, a unanimous vote was passed to invite the State Board of Agriculture to hold its next winter meeting in Fitchburg. You have honored us by accepting that invitation. In behalf of that society I extend to you now a most cordial welcome. We welcome you as representing in the highest and best sense the agricultural welfare of this old Commonwealth. A welcome to the hospitalities of our city will be extended to you by its chief magistrate in his official capacity. I now have the pleasure of introducing to you the Hon. Eli Culley, mayor of Fitchburg.

ADDRESS OF MAYOR CULLEY.

Mr. Chairman and Gentlemen of the State Board of Agriculture: — My medical adviser, who, in this instance at least, is my wife, said that, instead of coming out into the moist atmosphere of this morning, I had better stay in bed, as I have been suffering for three days from a severe headache; and those of you who are familiar with that trouble I have no doubt will heartily sympathize with me. I am also suffering from a sore throat; but my interest in agriculture, although indirect, is so great that I could not absent myself from this meeting, when I knew that the members of the Worcester North Agricultural Society, whom I esteem very highly, depended upon me for a few remarks to welcome you here on this occasion.

I regret very much that the inclemency of the weather has apparently deterred so many who are interested in agricultural matters from attending this morning, because I am sure that the interest which must be created by a meeting of this kind is so great that all who are engaged in agricultural pursuits or who are interested in them must of necessity gain much that will be of value to them. Still, I believe that those who are here will make up in interest and I trust in enthusiasm what they lack in numbers. I remember that at one time when I was serving in the army, my company and another of our regiment had been left behind under the command of the major, to blockade a back road through which it was expected that a part of the Confederate troops would come up on our rear and harass our own troops. We were detained for five or six hours, but eventually the major hurried us forward, and after we had gone two or three miles we heard the sound of incessant firing ahead. The major ordered us to "quick step," and a little later he gave the order to "double quick;" and we hurried to the best of our ability to catch up with our own troops, who were still far ahead. It took us some two hours to reach the desired point, and when we got there, after double-quicking it most of the way for some eight or ten miles, our numbers were quite small; perhaps in the two companies not more than twenty or twenty-five men were in the ranks. When we were near our own regiment, which was at the front and under fire at the time, the major looked down the short line and said, "Well, boys, there are not many of you, but what there are are good." So I trust it is with you here to-day; and I believe it to be so, that, although your numbers are comparatively small, you will make up in zeal and enthusiasm what you lack in numbers.

Farmers do not usually sow seed in December, and yet I do feel and believe that the seed which will be sown here to-day, to-morrow and next day, during the sessions of this Board, will be such that it will germinate and fructify for years to come, and that it will bring forth fruit for the honor and credit and glory of the agriculture of Massachusetts.

I had the pleasure during the last season of visiting what may be termed an experimental farm in the neighboring town of Rindge, N. H , owned by the Cheshire Improvement Company ; and it seemed to me from what I saw there, from the care that was taken to ascertain in what manner the best results could be obtained from the fine cattle that were shown to us, the beautiful horses that were exhibited, and the products of the soil,—it seemed to me, I say, that the owners of that farm were doing valuable missionary work for the interests of agriculture. They were expending large sums of money in experimenting as to how they could produce the best cattle, so that the result would be the greatest product of milk and butter ; what would make the best horses, both for speed and for purposes of a more practical nature. They were experimenting in the use of fertilizers ; and, as I said, it seemed to me that that missionary enterprise, if such it could be termed, was one that must result in abundant good to the agricultural interests of New England, because, although so much of it was on an experimental basis, it afforded to those farmers who have not the money nor the time to expend on such experiments the opportunity to profit by them, rejecting that which was of no value, and availing themselves of that which had shown itself to be good and right and best. So I say that a farm of that kind is of value not only to its own immediate surroundings, but it is of value to all of you who are directly interested in the pursuits of agriculture.

I might go on and say to you that I am very glad to see you, which indeed I am, as I feel that you have honored us by your selection of this city as the place for holding this annual meeting. It is an honor that we all as citizens of Fitchburg heartily appreciate, and for which I, as its humble representative for the time being, most heartily thank you. I am very glad indeed to see you here. I believe that the occasion will be one of profit to you. I trust that your meetings will be interesting, instructive and profitable; that you will feel and believe, when you leave us for your homes, that something has been added to your knowledge that will be of value to you for years to come, and that you one and all will hereafter look back upon this meeting with pleasure and satisfaction, and I trust that you will look forward in the future to a repetition of it with as much pleasure as we in the future shall be glad to see you here again.

The CHAIRMAN. I now have the pleasure of introducing to you the Rev. Charles S. Brooks of Fitchburg, who will deliver the opening address.

OPENING ADDRESS.

BY REV. C. S. BROOKS OF FITCHBURG.

MR. CHAIRMAN AND GENTLEMEN OF THE STATE BOARD OF AGRICULTURE: — Conventions are mountain summits which men of various vocations ascend for prospect, inspiration, deliberation and improvement of plans. You have come up onto this height of your annual assembly for discovery, and practical progress in your art of agriculture. I have read that "Canning used to say that the House of Commons as a body had better taste than the man of the best taste in it; and Macaulay was much inclined to think that Canning was right." Your convention doubtless will happily and helpfully realize this interpretation of Canning, and the summit of your wisdom will be reached in the aggregate of the genius of your membership. I am glad to greet you and participate with you as a company of seers convened to advance the standard of your craft. I may essay to speak briefly upon the theme, "The Threefold Vocation of the Agriculturist."

His official vocation is that of a husbandman. That goes without saying. When chosen deliberately and pursued enthusiastically as a science and a noble art, it is a vocation of great area and opportunity. One of your eminent apostles, Dr. George B. Loring, if therein a little extravagant, still had the salt of truth in his utterance when he said substantially, "It requires more brains to be a farmer than to pursue any other calling." It would be altogether true to say that more brains are found under some farmers' hats than under many of those in other guilds.

You will not, however, expect me to instruct you how to transmute your gardens into better gardens, or your rugged hill-sides into gardens; how to transpose and relate bowlder and loam, gravel, seed and tree, into delightful meads and fair orchards. That task I shall not assume. This rather will be done by the experts who are to address you.

I venture some suggestions upon two other phases of your sphere; for every rounded farmer must be at least three men. First, as I have said, he is to be a husbandman. And that, he is to be intensively and extensively. When the remark was made by a gentleman to Mr. Maydole, then for twenty-eight years a hammer maker of Central New York, "Well, then, you ought to make a pretty good hammer by this time," he replied, "No, sir; I never make a pretty good hammer, — I make the best hammer in the United States."

At the centennial exhibition held in Philadelphia, the Webster plough attracted my attention. It was, I believe, unusually large, and had with it these words of Daniel Webster: "When I have hold the handles of my big plough, with four yokes of oxen to pull it through, and hear the roots crack and see the stumps all go under the furrow out of sight, and observe the clean, mellowed surface of the ploughed land, I feel more enthusiasm over my achievement than comes from my encounters in public life at Washington."

Every farmer should in his calling aim to be what is for him colossal. Besides filling full his position as a farmer, he is to be a citizen. Under the genius of our American government, to be a citizen is as really his vocation. You, gentlemen, are builders of our republic. It cannot succeed best without your best service, and it can scarcely fail if you shall give it superlative aid. National stability and grandeur wait upon your bidding. For look at it. What is our case? We are, and are to be, increasingly for the present, a nation of cities. Already more than one-fifth of our population is in the cities. Take it in our own Commonwealth, and if the proportions remain the same as in 1885, we have about fifty-six per cent of the population in our cities.

Now, if American civilization breaks down, it will be in our cities. In New York City it did break down. All that saves New York City to tolerableness is the fact that it is ruled measurably at Albany, in the State Legislature. Local popular government has become there impossible. The rural vote, the farmer's vote, helps check the corruption. Chicago, we are glad to note, rises up in some of her exigencies in a masterful manner, and lays an unequivocal hand upon anarchism and murder. But the uncorrupted and incorruptible yeomanry of America are to be the reserve force ready to come to the front, after having governed well your own townships, and repress, through State laws, and if need be through State officers, municipal evils which cannot be controlled by the inhabitants of the cities. You are to be the counterpoise of metropolitan corruption. Do you raise the question, "Does not State interference with municipal affairs contravene and subvert the principles of popular government?" Yes, if by popular government we mean narrowly local government in individual towns and cities. But no, when we mean by it the people of a whole State, the cities included. The whole people are made the arbiters of conditions in their whole domain; and in emergency we must resort to the will of the whole people, or under municipal misrule come to ruin. It is an admitted dictum in national jurisprudence, that "necessity knows no law." If in our republic the people do not on exigent occasion rule the cities, the cities will both rule and ruin the republic.

I estimate the agricultural vote of the United States to approach one-half of the total vote. If it be so, you hold not only the balance of civil power, but, in connection with the contingent you are sure to get from the cities, you hold the power itself.

Mr. Bryce, in his "American Commonwealth," pens this ominous sentence: "There is no denying that the government of cities is the one conspicuous failure of the United States." I commend that to you, and those you represent, for consideration. It is within the power of your class to defend and forefend our nation from these perils of the city. Here in our State, as you make close inspection, your loftier monumental achievements are not these smooth slopes carved by untold toil from rugged hill-sides ; not the palaces and cottages, roofing, as they do, as much plenty and peace as generally are found under any equal number of roof-trees the whole world round ; not your famous highways and your network of railways, which have been created by dint of so mighty courage, patience and expenditure ; but your loftier monumental achievements are our public sentiment, our system of laws, our public school system, our higher institutions of learning, our churches, — all these, so largely the outcome of your fine citizenship, these are your glory as citizens, and the crown resplendent you have woven for the brow of Massachusetts.

In addition to the vocation of agriculture and of citizenship, you have the vocation of manhood. No office have you more imperative than that. When we lift our eyes upon the vast areas, practically limitless, stretching before the agriculturist, upon the mines of exhaustless treasure inviting and enchanting the capitalist, upon a country teeming with opportunities of gain for men from all sides of all seas, we make no doubt but that we are to have here in all callings, enterprise, daring, achievement. No question about that. But the higher question, lifting its voice through the din of ploughshare, mattock, shuttle, anvil and locomotive, is, "Are we to have manliness in America?" France has charming stretches of territory ; France has a free government ; France has men, — but not manhood as a characteristic possession. Brilliancy of imagination and wit she has, genius for art and talent for literature ; but not, as a distinguishing, culminating feature, manliness. There must be manhood in America, or we are doomed. Fertile acres, toiling rivers, fountains of petroleum, transcontinental railways and imperial industries, will not save us. The game in Europe may be learning or station or fortune or dominion ; but, while not scorning these, the game of all in America must be integrity. This, and all other worthy games, are sure to be won with it. Some astute thinker has intimated that "America is to be the home of men." The dominant type came hither to New England that they might be men. As our fathers on the coast of Massachusetts founded for their part the land, so let us finish it.

Gentlemen of the State Board of Agriculture, it is your high honor and privilege to pursue and dignify this threefold vocation of agriculture, citizenship and manhood. With each strand perfect, they make a threefold cord not quickly broken.

I take much pleasure in your presence for your annual winter session here in our city. If it be true that "a poet is born, not made," it is scarcely less true that a city's existence is fore-ordained. And so this city of Fitchburg, which has been called the "Heidelberg of America," has had its existence predetermined. By its natural circumstance God has said to the people of our Commonwealth, "Here arise and build." For here is the natural northern gate-way of the State, opening the avenue to the Miller's River and Deerfield River valleys; here are, upon the Nashua River flowing through our limits, various water privileges; here are picturesque slopes, presenting charming sites for residences; and here, divinely set, is Rollstone Hill, apparently of solid granite, prepared and waiting to be converted to various uses in the construction of the city. And the fiat of environment is, build here and prosper. And in obedience this municipality has been planted and has thriven. Very few cities of the State, I think, can have realized the per cent of increase since 1880, which Fitchburg has attained; for, from a population of over twelve thousand then, we have advanced, according to cautious estimate, to over twenty-one thousand, or some seventy-five per cent. A growth this is, I may add, which is founded on substantial industries, and which promises healthful stability to our city. We offer you our most cordial salutations and welcome as you convene for deliberation upon your department of work in our Commonwealth.

Mrs. Browning, who has been called "Shakespeare's daughter," looking out in Florence from her "Casa Guidi Windows" on the Italy she loved so compassionately, wrote: —

"'Now, tell us what is Italy?' men ask;
And others answer, 'Virgil, Cicero,
Catullus, Cæsar.' What beside, to task
The memory closer? 'Why, Boccaccio,
Dante, Petrarca.' And if still the flask
Appears to yield its wine by drops too slow, —
'Angelo, Raffael, Pergolese;' all
Whose strong hearts beat through stone, or charged again
The paints with fire of souls electrical,
Or broke up heaven for music."

Convened to-day in this ancient Commonwealth we love so profoundly, we may in turn ask, "Now, tell us what is Massachusetts?" And history may answer, "Brewster, and Standish, and Carver." What besides, to task the memory closer? "Why, Samuel Adams, Joseph Warren, and John Hancock." And if still the flask appears to yield its wine by drops too slow, all whose strong hearts beat through press or ploughshare or platform, or charged again law and letters and liberty with fire of souls electrical, or broke up heaven for manhood.

The CHAIRMAN. The first lecture will be by a gentleman who delivered a lecture from this platform before the State Board of Agriculture sixteen years ago, on "Grape Culture in Massachusetts." The cultivation of the grape in vineyards in Massachusetts was then in its infancy. The first vineyard planted in northern Worcester was planted by that gentleman. Others soon followed his example, so that there are now nearly one hundred acres in vineyards in this and the adjoining towns, yielding an annual product of from two to three hundred tons of fruit, and giving an income of from fifteen to twenty thousand dollars annually. I have now the pleasure of introducing Dr. Jabez Fisher of Fitchburg, who will address you on "Orchard Management."

ORCHARD MANAGEMENT.

BY DR. JABEZ FISHER OF FITCHBURG.

In these days of close competition in all kinds of business, it behooves the orchardist, if he cares to get in advance or even to keep abreast of his time, to let no opportunity slip whereby he may increase his product in the largest degree, without at the same time correspondingly adding to its cost. In consideration of this subject, I propose to present very briefly a few thoughts arising out of many years' experience, that may tend to give some light in the direction indicated. What I have to say will have special reference to the apple and the pear, and will be confined to trees that are already in bearing. A tree, like every other result of vegetative life, is a wonderful production. It is fixed in, and grows out of, the soil. It is acted upon by the sunshine and atmosphere, and is watered by rains. It has a period of youth, of maturity and of old age. The conditions of sunlight, air and moisture are much alike throughout any given district, but all soils within such district do not equally produce perfect trees. Science has shown us that some soils contain more of certain substances than others, and that in this fact largely lies the explanation of the difference in productiveness. A plant is made up of a variety of elements, a few existing in considerable proportions, while others are found only in small quantities, nearly all, however, being indispensable. Most of these are furnished by the soil and air in sufficient quantities for perfect growth. A few others are required in larger amounts than nature unaided is able to supply, and these it is the business of the cultivator to provide. It is comparatively easy to ascertain just how much of each of the various elements are required to produce an annual crop, as it can all be removed and subjected to analysis, in order to determine what has been taken from the soil. In the case of a tree this is not possible, because all of the product of any one year in the shape of wood, leaves and fruit, cannot be isolated; and therefore guess-work has to take somewhat the place of actual knowledge of what is demanded for continued growth and fruitfulness. Chemical analysis, however, does give us very nearly the proportions of the special amendments required, and our own judgment must be relied upon to indicate the gross quantities.

Fertilization.

Any fairly good soil will supply all of the elements necessary for the production of full crops, except potash, nitrogen and phosphoric acid, with some lime and magnesia. The forms in which the first-named three are furnished, their proportions and aggregate quantities, are those that specially concern us. Barnyard manure, which is composed of average hay and grain after having been ground up by the animal, and a small percentage of its soluble matters taken out of it for the sustenance of the same, contains all three in about these proportions per ton: potash, ten pounds; nitrogen, nine pounds; and phosphoric acid, four pounds. There is no better fertilizer for the production of hay and grain than barnyard manure, which is a complete fertilizer. For some special crops it is necessary for the best results to supplement it with variations of some of its leading constituents. Some of the objections to its use by the orchardist are: it usually cannot be spared from other crops; if bought, it is too costly; if used, it involves for its best utilization cultivation of the surface, which is not desirable; it is slowly soluble, and does not minister most to the demands of the trees when most needed; and, finally, its proportion of nitrogen is too large for fruitfulness, although right for young growing trees. For some years past I have adopted a plan of management which has given me much satisfaction. The trees stand in sward. As soon in the spring as the frost is completely out of the ground and it is free from surplus water, I spread from a cart a compounded fertilizer. I wish to furnish for each acre about seventy-five pounds of potash, thirty pounds of nitrogen, and twenty-five pounds of phosphoric acid, as the leading constituents, deeming that a fair annual application to promote growth and productiveness and holding the best proportions that experience indicates. The formula used the past season was made up as follows: —

Cotton-seed meal,	225	pounds.
Muriate of potash,	140	"
South Carolina floats,	75	"
Sulphate of ammonia,	60	"
Nitrate of soda,	20	"
Ground plaster,	80	"
Total,	600	"

This cost me at the railroad station just about $10.00. To this I should add, another season, a quantity of sulphate of magnesia. The merits of this application are: its small cost, considering the value of its ingredients; its ease of handling; the large proportion of soluble constituents immediately available; and the relative proportions of its components, which may be varied just as desired. Notwithstanding it ministers at once to the growth of the grass, on account of its solubility the trees get a generous share. As soon as the grass will stand up against the scythe, it is mowed and placed around the trunks of the trees to a depth sufficient to kill out and keep out all grass, and of as much width as the varying amount of cut grass will completely cover. This mowing is repeated through the season as often as the grass is tall enough, from two to five times, depending upon the rainfall mainly.

The advantages of this plan as a whole are, that an orchard is cheaper fed than by animal manures; it is better fed for fruitfulness by reason of the different proportion of its constituents, notably the smaller amount of nitrogen; it is also better fed on account of its greater solubility, which causes the leaves to develop rapidly, and at once put on that dark-green color characteristic of sturdy health, thus promoting a successful fructification of the bloom and a vigor of growth throughout the season. The grass when kept short does not exhaust the soil to the detriment of the trees, either by its demand for the elements of fertility or moisture. It fills the soil with dead and decaying roots better than the plough and cultivator can with manure. The cut grass readily decays, and, acting first as a mulch and then as a fertilizer, finds its way back eventually to the soil. When the leaves drop in the autumn they are evenly distributed among the blades of grass, and never blow away, thus returning to the soil so much of fertility. The cost of mowing is not more than that of cultivation. The fruit will be of a more compact texture, and will keep longer than with a cultivated surface, and the trees will be freer from disease and longer lived.

Insects and Their Destruction.

Some years ago, when fair, clean No. 1 apples might be worth $3.00 per barrel, No. 2, mainly good apples but wormy, would sell for $2.00. Now, this proportion will not hold. The No. 2's under the same circumstances bring from $1.00 to $1.50. This comes about from the relatively large proportion of the inferior fruit, which has constantly increased, and, in the absence of an effectual preventive, must continue to increase. In years of small crops nearly all of the fruit will be of this poor character, and it is only when the production is very large that any considerable proportion is free from insect injuries. Various remedies have been proposed, which are partially effective; but I know of only one that is worthy of serious consideration generally. Arsenical preparations, if properly and persistently applied at the right time, will be found to be more valuable for this purpose than any other treatment that has yet been brought forward. There are three forms in which arsenic has been used: viz., arsenious acid, or white arsenic; Paris green, or the arsenite of copper; and London purple, a waste product of somewhat uncertain composition. I have experimented a good deal with white arsenic, but find that it cannot be depended upon at any strength which will save the foliage from injury. Paris green is safe, and may be sucessfully used with sufficient care; but I give preference to London purple. Paris green is so heavy a powder that it settles almost at once in the water, and, unless constantly stirred, it is impossible to distribute it evenly over the tree. London purple is much better in that respect, and probably for that reason is more effectual and gives better satisfaction. It should be used at the rate of one pound of the purple to from one hundred and fifty to two hundred gallons of water. If stronger than the first, it will be liable to burn the foliage in spots; and, if weaker than the latter, it is only partially efficient. The foliage of pears is more tolerant of it than apples. An even teaspoonful to two gallons of water is about right, but as they vary in capacity, I would advise measuring your teaspoon, so as to make it definite. The liquid can be best applied by means of an ordinary brass hand-syringe, with a fine rose. It should be thrown with force in order to form as fine a spray as possible, into and above the tree from every side, so as to wet the whole foliage. That which falls upon the ground is useless, but no harm comes from an excess. Two gallons evenly applied will be sufficient for a tree capable of bearing four barrels as a full crop. The first application should be made as soon as the trees are out of bloom, the second say seven days later, and the third ten days after the second. If no rain occurs from the time of the first spraying until three days after the last, the protection should be at its maximum ; but rains are common at that season, and often interfere seriously. In such an emergency, the applications may be made directly after a rain if the foliage is dry, and it will be useful if only twenty-four hours intervene before the next rain. Just how this simple operation produces the effect that follows, is not entirely clear in all respects, but it is probable that the curculio, which is responsible for much of the deformed fruit, produces this condition by taking bites out of the skin of the forming apple or pear. Development is arrested at these spots, and as the substance of the fruit around grows, there is formed a knurl which increases as the specimen enlarges. It is possible also that the female eats the chips she makes when forming the crescent excavation. It is easy to comprehend how the young codling worm, hatched on the outside of the skin within the calyx, consumes an atom of the poison before entering the substance of the fruit.

Thinning Fruits.

Inasmuch as the largest and most perfect specimens are those that pay the best profit over the cost of production, I come now to consider the mode of procedure that will result in the greatest proportion of such, and at the same time reduce all others to the minimum. This is quite possible by a small expenditure of intelligent labor applied at the right time. If the arsenical spraying has been effectually used, most of the fruits will have been saved from the injuries caused by insects. When they have attained the size of from one-half to one inch in diameter, it will be time to commence a systematic thinning. As a rule, bearing trees set many more fruits than they can carry to perfection ; and, for the benefit of those which are to mature, all others should be removed before they have made much demand upon the fertility of the soil or the strength of the tree.

This operation is conducted as follows, preferably by boys or young men: 1. Wherever two or more specimens of the apple or pear set in a cluster, all should be picked off except the best one; 2. All those deformed in any way that would take them out of the No. 1 class at maturity, should be removed; 3. All that show the presence of worms should not only be taken from the tree, but should be treated so as to destroy the worms, either by feeding to animals, or by cooking or burying; lastly, all that are decidedly smaller than the average specimens left should be removed.

After all this is completed, it becomes a question of judgment whether the fruits remaining shall be further thinned. Experience only can teach the best point at which to stop in each individual tree; but, even with the experience of years, we shall be likely to finish prematurely. At the time at which the work is done the fruits are small, and we do not and can not appreciate how differently the tree will look when the fruit has reached its full size; and the tendency is always to an underestimate. Perhaps a good rule is to allow no fruit within six inches of another in any direction. Even at this distance, if a tree was evenly filled throughout, the yield would be enormous.

It is obvious that careful spraying and faithful thinning combined must result in a greatly superior product, that will afford a much larger margin for profit if the increased labor and expense do not consume it all. It is easy to arrive at the exact cost of each of these operations, but more difficult to get at the difference in crop value resulting therefrom. From an experience of more than twenty years in thinning pears, and half as many in apples, I am fully persuaded that labor expended in this way is worth always more than twice what it costs, and in some cases more than five times. A few of the fruits would drop before picking time, but the great majority of the fruit would have to be picked by hand finally, and two small ones can be removed quicker than one full grown. In fact, I am not sure that it costs an additional cent to take them off early, but I am confident that it adds to the value of the remaining product from twenty-five to one hundred per cent. It pays the largest profit when the crops are the heaviest. When the yield is immense, the difference in value of the firsts and seconds is greater than under other conditions. In 1888, when the apple product was very large, and a great proportion went begging at small prices, first-class fruits sold for fully three times the price of the others.

Handling and Marketing.

Having produced a superior article, it is of much importance that it be utilized to the greatest advantage. If the fruits are intended for late keeping, they should be picked early; i.e., before any considerable number of sound specimens drop from the trees, and before they get a high color, if of colored varieties. They should be at once housed in the coldest place attainable, out of the influence of the sunshine, and as far as possible in an even temperature. Fruits sweat as a cold pitcher sweats, which is only when it is colder than the atmosphere that surrounds it; and every time this occurs it hastens the process of ripening. If apples are to be marketed early, and the best quality is wanted, they may remain on the trees until they obtain a high color, and show maturity by dropping. Pears should never be allowed to become eatable while upon the tree. No fruit should be allowed to drop from the hand or otherwise, but should be handled precisely as an egg. A slight dent in the surface of an apple made by a fall of only a few inches will not cause it to rot; but the spot consists of dried apple, which injures its good looks and is an obstruction to the action of the parer. Any rupture of the skin, however small, starts decay, which is worse in pears than apples.

In assorting fruits for market, it is very important that the barrels or other packages run even for both size and quality. The most taking display, and the one which quickest attracts the buyer, without perhaps his appreciating the reason, is one in which the specimens, while not necessarily of unusual size, are models one of another, no very large and no small ones, which equally destroy the beauty and attractiveness of the whole. If the crop varies much in size, it is better to pack the largest by themselves. In this kind of business, as in every other, "honesty is the best policy;" but he who is honest simply because it is politic, will be equally a scamp when he happens to believe that to be the most politic course.

The limit of time which was assigned me forbids the further elaboration of the points touched upon, or the mention of others of less moment. To sum up the subject in a single sentence, I would say, if the orchardist will annually feed his trees properly and generously, will prevent other growth from undue interference, will make the best use of arsenical spraying, will thin his fruits faithfully at the right time, and handle the product with care, he will be likely to be as well recompensed for his trouble as the business is susceptible of.

The Chairman. I want to say that this hour has been reserved for questions and discussion; it is for you, gentlemen, to improve it. The doctor will be ready to answer any questions.

Question. What varieties of apples have you found the most profitable?

Dr. Fisher. If you want to set out an apple orchard for profit, I doubt if you should talk about varieties at all; you should set out one variety, if it is all for money. And yet I should hesitate before putting all my money into one variety. The story used to be, that, if you wanted to set out a thousand apple trees, you should set out nine hundred Baldwins. "Well, what should the other hundred be?" 'Well, Baldwins." I do not know but that is true to-day, but I have some doubts about it. I think I get more money out of Hubbardstons than I do out of Baldwins; yet I do not think I should advise a man to set out a thousand trees of the Hubbardston variety. The market varies. I do not think that any man can tell what will be the most popular apple twenty-five years from now. There is a good deal of guess-work about it. I should say, if you want to set out a pear orchard for profit, set only the Bartlett. Still, we want some other varieties.

Question. What do you think of the Rhode Island Greening?

Dr. Fisher. The Rhode Island Greening on my land does very well indeed. Most people in this region do not succeed with it; I do not know why.

Question. About its popularity in the market?

Dr. Fisher. It is an apple that never is popular until it is known, and after it is known it is more popular than the Baldwin. The Rhode Island Greening is not so well appreciated in Boston as it is in New York. It will always bring in New York fifty cents a barrel more than in Boston; I do not know why, but it is the fact. When apples were first exported to England, the green varieties brought very low prices; but they are beginning to appreciate the Rhode Island Greening there now, and they will pay almost as much for it as for a red variety. For retailing, a red apple is much better than a green one; but for cooking purposes the Rhode Island Greening is far ahead of the Baldwin.

Question. How about the Gravenstein?

Dr. Fisher. The Gravenstein is a very fine apple indeed. It is one of the best apples for exportation. Nova Scotia has found that out. They are growing enormous quantities of Gravensteins there.

Question. How about the profit, compared with the Baldwin?

Dr. Fisher. There is one great objection to the Gravenstein. It is an apple that does not ripen all at once, and therefore you must pick two or three times in order to get the best results. I have known people who mulched the ground underneath their trees, and allowed their apples to drop; but that, of course, spoiled half of them.

Question. The Northern Spy, doctor?

Dr. Fisher. It is a very fine apple, and brings high prices, but I think it costs a good deal of money to get it. The trees are late in bearing, and it must be handled very tenderly or it does not keep until the time of the year when it is valuable.

Question. Is it best to trim pear trees? Does not mulching tend to bring the roots nearer to the surface, so that a drought will affect them more, and also attract mice?

Dr. Fisher. After pear trees have arrived at the bearing age there should be very little trimming done. As long as the trees grow excessively, make long limbs and a great many of them, it is necessary to thin them out. It will never do harm to cut out the dead wood or a crossing limb. It is not necessary to prune apple trees much, although occasionally some is required. It is better in all pruning to do it early. It is better to prevent the growth that you do not want, than it is to wait till the wood is made and then cut it out. The time of pruning is not very important, although perhaps it is better to prune in the fall than in the spring. If you have a large limb to cut out, it should be done very carefully, leaving a stump a foot long, more or less, and then wait until June and cut out the stump; paint the scar, and you will never have trouble from it. But, if you cut out a large limb in April, the chances are that there will be an oozing of sap, which turns black, runs down the tree, and it commences to decay. That you can always avoid by leaving a stump, and cutting it off some time in June. You may ask, "Then why not prune in June?" It is very bad to take out much foliage after it has developed; it checks the tree amazingly. That is one way of getting a tree into bearing, when it grows all the time and makes wood largely.

If you put grass about your trees in a wet year, like this one, the grass decays and becomes mould, and then there is no trouble from mice; but when you mulch your trees in a dry year, the grass dries and becomes hay, and it will be filled with mice. The simplest protection that I know of is to surround each tree with tarred paper, tie it together to hold it in place, and mice will never touch the tree. It will not cost a tenth of a cent to protect a tree against the ravages of mice or rabbits all winter.

In regard to the roots coming up to the surface, that is just the thing that we want. I would like to get the roots of my fruit trees up to within an inch of the surface, if I could. The trouble with ploughing is, that you do not allow them to come within less than six or eight inches of the surface; you keep them down out of the way of the influence of the sun. I mulch to get the roots up as near the surface as I can. I think my trees do better for it. The ground is always moist under the mulch, and when the sun comes out the roots never decay in consequence.

QUESTION. What are the advantages of root-pruning?

DR. FISHER. The advantage of root-pruning trees is precisely that of root-pruning corn. After the crop has filled your ground with roots, does it do any good to cut off some of them? It simply prevents the crop from growing to the extent of its roots. Every tree or plant that is unmutilated from beginning to end has a branch corresponding to every root. If you cut off a root in any way, you either kill the branch corresponding to it or you make it stand still; or, if you cut out a branch of a growing tree, you kill the root which corresponds to that branch. The severing of that root deprives that branch of its nutriment, and *vice versa*. That is just what will result from any cultivation that cuts off the roots of growing plants.

QUESTION. Have you any remedy for the cracking of pears, — the Flemish Beauty, for instance?

DR. FISHER. Yes, sir; I have a remedy for the cracking of the Flemish Beauty. It is the remedy that the Frenchman applied to his dog. He cut off his tail right behind his ears. I don't know of any other. I don't think it is possible to grow the Flemish Beauty as a crop in this part of the country. Occasionally you get a perfect crop; but my experience is, that about nine times out of ten the fruit is entirely worthless. In city yards, in protected places, I have known trees to bear several perfect crops, but never in a field or orchard.

QUESTION. If you have some good trees, would you graft them with something else?

DR. FISHER. I would.

QUESTION. Can you do anything with cherry trees when knots or warts get on them, except to cut them down?

DR. FISHER. There is no difficulty if you keep the black-knot cut out. You must cut it out whenever you find it, and you must look for it, too. It spreads by spores, like all the other fungi, and if it is cut out in the early stages it cannot spread from that source. If you live in a region that is surrounded by wild cherry trees, cut them all down. It is no use to fight against the black-knot in your own trees if wild cherry trees are growing all around you; you must remove the source of infection. You must cut out the knot and burn it, so that the spores cannot propagate.

QUESTION. Does that rule apply to the plum tree as well as to the cherry?

Dr. FISHER. Yes, sir; precisely.

QUESTION. What would you do when they come out all over a tree simultaneously?

Dr. FISHER. Why, I should cut in the same way.

QUESTION. Cut at the bottom?

Dr. FISHER. I should cut at the bottom. If you had a plum tree in your yard that you valued very highly, and took a great deal of pleasure in, you might, perhaps, cut out a hundred knots, where you would not if it was in an orchard. It is a question of dollars and cents in any case.

QUESTION. Do you consider the black-knot liable to be communicated to other trees?

Dr. FISHER. Yes, sir. If you let it alone, you will find that it will always spread. It has two sets of spores, — winter spores and summer spores. Both of them will spread. The only way is to cut them out at any and all times, and burn them.

QUESTION. What varieties would you graft on the Flemish Beauty?

Dr. FISHER. Whatever varieties I wanted. Almost anything will thrive in a good stock.

The CHAIRMAN. We will let this matter rest now, and invite Mr. Augur to take the floor.

Mr. AUGUR. Mr. Chairman, I was very much pleased with the lecture that Dr. Fisher has given us, and I hardly feel like combating it at all. I have not for a long time heard anything with which I so heartily agreed. In regard to the black-knot, I would like to say just a word. I have been into a battle with that, and came out beaten, I must confess. I had the same idea that he has of cutting it out, and I calculated to cut out every black-knot that I saw; but the time came when it became epidemic, as it were. Whenever it came on, and almost at the same time, you could see a green exudation coming out all over the trees, and I had to cut away a good many trees. I have come to the conclusion that it is better to choose those varieties that are the least subject to the black-knot; but, in attempting to answer the question, "Which are those?" I am a little at a loss to know. The Shropshire Damson, which I consider, aside from that, the most profitable plum that we have raised, is very much subject to it, and we have stopped planting it. But for that I should call it the best market plum we have. The Lombard, which is a profuse bearer, is also very much troubled with the black-knot. It has troubled us so badly that we have stopped planting that variety. The Imperial Gage so far has escaped the black-knot, when others have broken out with it all around it. The German Prune, Pond's Seedling, and the Niagara, have been comparatively free from it, although not wholly so. I would advise those who are engaged in poultry raising to have a plum orchard for their poultry yards. In that way they would escape the ravages of the curculio to a large extent, and the droppings of the fowls would very materially help to fertilize the trees.

QUESTION. Before you leave that subject, will you state how long your plum trees have been under cultivation?

MR. AUGUR. I cannot say that they have been under cultivation exactly. They were planted pretty thickly in the hen yard, and being enclosed, and the fowls having a run there, we do not attempt to raise any crop, and have not kept up continuous cultivation.

QUESTION. How old are they?

MR. AUGUR. I should say twelve or fifteen years.

MR. HAWKINS of Lancaster. I would like to ask the gentleman if he thinks the moist weather we have had for the last two seasons has been conducive to the spread of the black-knot?

MR. AUGUR. I have not traced it particularly to that.

MR. HAWKINS. I have some forty-five hundred plum trees, and have not had any black-knot until within two years; and as fast as it appears I cut it out. This year I had to cut out a whole orchard, to get rid of it, and I attributed it to the moist season.

MR. AUGUR. The disease seems to propagate by spores, and it has certainly seemed to be epidemic. The potato rot comes from spores, and there are seasons when its ravages are very much more severe than others, and this last season it might very naturally be attributed directly to the wet season; but there is something back of that, I think, that we do not know of.

In regard to the apple orchard, I most heartily concur with Dr. Fisher in what he said about the matter of pruning. I wish every one might carry his ideas home, and ponder them well. I think young trees, just as they are transplanted, are hardly ever pruned enough, and old trees are almost always pruned too much.

I like a tree that is well supplied with roots, evenly balanced root and head; and when it is compacted, well set out, I would like to take out three-quarters or more of the top, and there will be no need of staking; the tree is there, it is going to hold there, and it will grow. And if we can prune our trees so that we shall have just so many main branches and so many secondary branches, and prune from time to time so as to balance the tree, and cut out the superfluous branches, I think we shall then have the beau ideal of a perfect tree. I have looked through Connecticut to find a perfect orchard, and have not found it. I have not seen one in Massachusetts, and if there is one within a long distance I should be happy to go there to get a look at it. We do not carry an ideal in our minds, and endeavor to bring our orchards up to it. But, in order to do that, I think we should start with a perfect tree; and if we have a perfect set of trees in an orchard, that orchard will be uniform, and then, with proper care and culture, as has been recommended, we shall have profitable orchards.

About 1854 I planted an orchard, mainly of three varieties, — the Baldwin, the Rhode Island Greening, and the Roxbury Russet. I selected those trees from a model. For the first ten years there was not a missing tree in that orchard. About that time a man in my employ managed somehow to spoil one of them by driving over it; but with that exception the orchard remained intact for several years more. Since that time, from one cause and another, perhaps four or five trees out of the entire number on the two acres have gone. Aside from that, the orchard is very uniform and has been very productive, and I think that is what we should aim at.

Again, I think that on all our farms we have too many scattering trees. They tempt cattle to break through fences, furnish a breeding-place for worms, and the fruit cannot be gathered with any profit when the extra time required is considered. Unless they have unusual merit, I think all such scattering trees should be removed. If we would just take them to the wood-pile and set out a new orchard, selecting choice trees and keeping them up to a good standard, I think we should vastly improve our farms.

In regard to varieties, I think I should agree with the lecturer that the most profitable orchard we can have is one wholly of Baldwins. I speak from my own experience. The Hubbardston is an apple that does nicely with us. It wants handling early. They ought to be disposed of by this time, or before.

Dr. Fisher. No, sir.

Mr. Augur. I stand corrected for Massachusetts, but not for Connecticut.

Dr. Fisher. I dispose of mine usually in the month of January. They bring the best price at that time.

Mr. Augur. I should presume they would. I have no doubt Dr. Fisher is correct about that in his locality. There is an apple which has pleased me very much. I do not know how it has succeeded here, or how much it has been disseminated. I refer to the Grimes' Golden. At the New Orleans exhibition I had occasion to see it from different localities. It was rated as the best apple at the exhibition. It is an apple, I think, of high quality, and it seems to me that every farmer should at least have some for his own use; and as people become better acquainted with it, and as it is more widely disseminated, I think it will be a popular market fruit. In the fall I think there is no apple like the Gravenstein. A gentleman asked me a short time since as we were riding in a stage, "What do you call the best apple, all things considered?" "Well," I said, "I should be almost inclined to choose the Gravenstein." When we have a surplus of those apples, we frequently put them through the evaporator, and they are just as much finer than any other apple I know of for cooking all through the year as they are for eating in their season.

QUESTION. How does the Oldenburgh compare with that?

Mr. AUGUR. It is a handsome apple, but I do not compare it at all with the Gravenstein in quality. There is a most delicious aroma about the Gravenstein. Stewed with a little sugar, it makes one of the finest desserts, and one of the cheapest, too. It does not take very much sugar, and I know of no fruit, unless it is the peach, that compares with it for cooking. Where a man has room for only one apple tree, I should recommend him to put in the Gravenstein. In the Boston market, when the Porter, which ripens about the same time, brings $1.25 a barrel, the Gravenstein brings about $2.00. I think there is about that difference.

In regard to the Baldwin apple, a commission merchant from New York was in my orchard this fall, and he complimented me as having the best orchard of Baldwin apples that he had seen. They were very highly colored, and he made the remark that the Baldwin, other things being equal, was valuable in proportion to its color; and I think so too. A high-colored apple, whether it be a Baldwin or a Northern Spy, is the apple for me. It has quality, as well as being more merchantable.

QUESTION. Is there not considerable difference in Baldwins? I mean different kinds; some that redden up a good deal more than others?

Mr. AUGUR. Well, I should not lay so much stress upon that as upon the environment of the tree. People sometimes ask if there are not two or three kinds of Rhode Island Greenings. Well, so far as that is concerned, I might say there are twenty; but I think it is owing to the circumstances and surroundings more than anything else, although when we are grafting trees we like to select scions from the very best trees. I think that is always in order, either with apples or anything else.

A word in regard to the planting of young orchards, — for our old trees are disappearing, and, in order to have the next generation supplied with fruit, we must plant orchards. It seems to me that we should pay very much more attention to getting a fine quality of nursery stock. I am very sorry that the custom is so prevalent of propagating trees by root-grafting. Some one was asked when was the best time to begin training a child, and he said a hundred years before it was born. I think he was right about that. I think we should get seed from good native seedling stocks, that are healthy, vigorous, and that have well-developed seeds. Seedlings are almost always graded into about three grades, — extra, No. 1 and No. 2. Now, if I could have my choice, I should want my trees from the extra stock, no matter what they cost.

QUESTION. Are not those grades fixed according to size rather than quality? That is the way they do it in the catalogues.

Mr. AUGUR. I think there is a great deal in the character of the seeds. You take any number of apple seeds, and you will find two, three, four or more grades. There will be those that are very plump and those that are very diminutive. If we select fully developed seeds, they will produce the finest seedlings, of course. We should take advantage of the best heredity we can get, and that is the starting point. An orchard so selected and so planted could hardly fail to do well. It does not matter how much you pay for the trees. If you pay fifty cents for one tree, and could get the other at a dime, I should take the higher cost one in preference to the other, for I should then have something reliable to start with. I will venture to say that you may go around Fitchburg or any other place, and look over the orchards, and you will find two-thirds of the trees not what they ought to be. A great many trees that are set out from nurseries have roots only on one side, and consequently you will find a great many leaning trees in the orchards.

QUESTION. Has not the wind something to do with that in some localities?

Mr. AUGUR. When the wind blows, it is the one-sided trees that get over. I like to have the wind blow, and if a tree does not stand it, let it go. But when you have an orchard that has come to maturity, do very little pruning. I know an orchard in our town that was bought by a clergyman, and he thought he was doing the best thing possible when he put a man into it who did not know very much about pruning to do that work. After the pruning was done, I happened to pass the orchard, and I thought to myself, "Well, one more pruning and you have your fire-wood." The orchard was just ruined, in my opinion, by that excessive pruning, which left just a little tuft on top of four or five main branches, and aside from that the tree was gone. The next season the trees will undoubtedly be full of suckers, which will be a nuisance; and I consider trees which have been pruned in that way, three or four large branches taken off, just about ruined. I would rather an old orchard should be a little too thick, than to have it so mercilessly pruned. But what is better is to go in and thin out, as Dr. Fisher has said, any dead wood and any branches that cross each other, and then let it alone and get what you can from it.

QUESTION. I would like to ask the gentleman if he has had any experience with the Newtown Pippin?

Mr. AUGUR. I have a few trees of Newtown Pippins, and I rather value them, but I do not consider it a profitable apple for market. On the Hudson it formerly did remarkably well, and brought very high prices in England; but even there it does not at the present time hold its former ascendency. It needs high culture.

QUESTION. I would like to ask Mr. Augur if he has any preference in regard to localities?

Mr. AUGUR. Yes, sir; I would not advise any one to plant an apple orchard in the vicinity of a city on land that is good for truck gardening. But if a man has an old pasture which has not been ploughed for a good many years, where the land is rather heavy, I think that answers very well.

Professor STOCKBRIDGE. We have two experts here, and I think we ought to pump them thoroughly. Some very important matters have been brought out by Dr. Fisher and Mr. Augur, and I have one question which I would like to ask. A few years ago we were told to cultivate our orchards, but not to undertake to grow two crops, — a crop of trees and a crop of hay. It was everywhere said that you must cultivate your orchards, keep them clean like a hoed field; and to this day I think that through the Middle States the peach orchards are kept cultivated. In Florida the orange groves are all kept thoroughly cultivated. Now, Dr. Fisher does not hold to cultivation; he would keep an orchard in grass, and mulch the trees so as to get the roots near the surface. I would like to know from Mr. Augur what advice he would give in that respect. It is a very important matter.

Mr. Augur. It certainly is. I think that it depends somewhat upon circumstances. I have an orchard that was planted in 1869, which I kept in cultivation I think four years. The trees then had a good stand. We had been raising peaches, grapes and other fruits, and of course it is necessary for us to have hay. We have to devote a considerable portion of land to hay for our stock. As I said, that orchard was planted in 1869. In 1872 or 1873 it was seeded down to grass, and has not been ploughed since. It has been pruned and it has been top-dressed. I presume Dr. Fisher will criticise me on this point; but I will say that the hay from that orchard has been taken to the barn; but the orchard is coming very nicely into bearing. At the end of summer, or perhaps about this time, we clean out all our manure and top-dress the orchards.

Professor Stockbridge. Then I would like to ask another question, which perhaps should be put to Dr. Fisher. Provided you cut that grass and carry the hay to your barn, is any damage done if you increase the per cent of fertilizers which you put upon the land?

Dr. Fisher. I want to make this point emphatic, — that you cannot grow hay and apples on the same land. I want you to cut your grass before it becomes fit for hay, while the blades are not more than six or eight inches high, and its roots are correspondingly only six or eight inches long. If you wait until the grass is three feet high and the roots are three feet long, approximately, and then cut the grass and take the hay to your barn, you have stolen from your soil both moisture and fertilizing properties, and you cannot bring them back.

Mr. Augur. In that connection I would like to say that I think there are sometimes evils growing out of cultivation.

I will mention a case which will give my idea. I knew a small orchard that was set out some years ago which was treated as a garden, with pretty high fertilization. Those trees grew enormously. They grew too much and grew too late, and at the end of about six or eight years that cultivation ceased, and then the other extreme was taken up, of cutting the hay and removing it. Well, the revulsion was so great that those trees came to a stand, and very soon began to decay. I presume if the cultivation had been kept along, they would have continued fruitful perhaps for a period of years. But it seems to me that excessive culture is bad. What we want is a moderate, uniform growth, in which the terminal buds shall be formed as early as August, and no further extension of growth after that. Let the sap be elaborated and the wood well ripened up. I have at home specimens of peach trees that have failed prematurely, and I find that those peach trees, during a period of two years of their growth, made an enormous amount of wood, and I think they suffered in consequence.

In regard to the matter of mulching, I fully believe in that. I have as little fear as Dr. Fisher has in regard to the roots coming near the surface. I saw in one of the papers some remarks of Professor Budd of Iowa, deprecating mulching on account of trees winter-killing; and the thought occurred to me that very likely cultivation might have been given up and a revulsion occurred similar to that of which I spoke in the orchard which was cultivated like a garden. I think we should go along uniformly, not give excessive culture; and, if we stop culture, be sure to provide sustenance, so that the trees will not stop growing, but continue right on.

The CHAIRMAN. I have been requested to call upon Mr. Hawkins of Lancaster to give his experience in the cultivation of the plum in the hen yard.

Mr. A. C. HAWKINS of Lancaster. On this plum question I must say I have been rather beaten this year on account of the black-knot, which was discussed this forenoon. For eight years I have been quite successful in cultivating this variety of fruit. The trees have been set in hen yards, about fourteen feet apart, and the only fertilizers have been the droppings of the fowls, and a coating of ashes once in two or three years. The trees have grown thriftily, and after they were three years of age they have borne bountifully. This black-knot, which I think has increased on account of the excessive moisture we have had for two or three years, has not decreased the crop as yet, but this fall there is a great deal more of it than I have ever seen before. I do not know what the outcome will be; but if I should go over some of my trees and cut off all the knots, there would be very little left. I think I have about forty-five hundred plum trees now, and perhaps only a hundred or two are affected badly, so that I do not fear anything serious for a year or two. I am setting new trees every year, and I shall not be discouraged until they all go. I think in setting plum trees or any fruit trees great care should be exercised in selecting the trees. Last year I set about two thousand plums and pears; and, as I could not get satisfactory prices in this section, I went personally to the nurseries in Geneva and Rochester and other parts of New York where they are grown as a business, and made my own selections; and I found it saved me a great deal of money, and I got trees of a quality that it was impossible to get of the agents. I learned from these dealers that many of the trees that are purchased and sold at high prices to the general dealer are only second or third quality. You can go there and buy the very best quality of trees, true to name, for twenty-five per cent less than you must pay to agents for poor stock.

QUESTION. What about the curculio?

MR. HAWKINS. I have no trouble from them. A small proportion of the fruit gets stung by the curculio, but the fowls run among the trees and destroy all the increase.

QUESTION. How many fowls does it take to destroy the insects on an acre?

MR. HAWKINS. I should say that five hundred fowls to the acre would keep down any increase of the curculio; and if the trees are set outside of the hen yard, and care is taken to gather all the fruit that drops from the stings of the curculio and it is fed to the fowls and hogs, the grub in the fruit will be destroyed, and there will be no trouble. At least, I find it so, and I have two thousand trees outside the hen yard. I have average crops every year. It may be that I raise so many that the curculio cannot sting them all.

QUESTION. Do you ever spray your trees with Paris green?

Mr. HAWKINS. I have never had occasion to.

Mr. AUGUR. I would like to ask which varieties of your plums have been most troubled with the black-knot? Have you noticed any difference in the varieties?

Mr. HAWKINS. My worst trees in that respect are the Damson and the Purple Gage. I have an orchard of Lombard trees that have been set for ten years, and they have never had knots enough on them to injure the crop to any extent. The Quackenboss seems to be the freest from the disease in my locality.

Mr. AUGUR. Have you the Niagara?

Mr. HAWKINS. I have. I suppose they are the same as the Bradshaw. That is what the growers tell me at Geneva.

Mr. AUGUR. There is a little difference between them, I think.

Mr. HAWKINS. They call them the Niagara in order to sell them for a new thing; but they are practically the Bradshaw, as far as I can see. I bought a few at a high price, but they all bore Bradshaw plums.

The CHAIRMAN. The hour of adjournment has come, but Professor Humphrey, of the Experiment Station, is present, and I know we should all be glad to hear from him on the subject of the black-knot.

Professor HUMPHREY. Mr. Chairman and gentlemen, I am not here to talk to-day, but when I saw the eye of the secretary on me I knew I was in for it. This question of the black-knot is one on which I have not much to add to what has been said in the bulletin of the Hatch Experiment Station of the Agricultural College for October, which some of you I presume have read. I can tell you in a very few words what we know about the black-knot. It would take a good many more to tell you what we do not know. The swelling in the branches known as black-knot or wart on cherry and plum trees is caused by the attacks of a little plant. It is just as truly a plant as the plum tree that it attacks. The disease is propagated by reproductive organs known as spores, which are analogous in their function to the seeds of the higher plants. This plant is one of the thousands and thousands of so-called fungi, which constitute a very large brood of small, largely microscopic plants, which attack either dead and decaying plants and animals, or living plants. Those which attack living plants, like the black-knot fungus, are known as parasitic fungi, because they live on and at the expense of the plants which they attack, drawing their nourishment from them; having no power of elaborating nourishment for themselves, as the green plant, a plum tree, for instance, has, but depending entirely upon the nourishment elaborated by the plum tree for its food. The reproductive organs or spores are very small in all the fungi, microscopic in size, and so naturally very light. They are readily carried by the wind and by very slight currents of air. The early history of the development of the black-knot fungus we do not know. We do not know definitely how it first penetrates the branches; we can judge of that only from its analogy to other fungi.

The spores presumably infect the branches of a plant by producing little germinating threads which grow out from the spore and push their way, you might almost say *dissolve* their way, perhaps by some chemical action on the surface of the branch, into the interior of the branch, through the dead cells of the bark into the living, active cells of the new wood, living at the expense of the nutritive material which has been elaborated by the plum or cherry tree. The body of the fungus is composed, like the body of all the fungi, simply of little whitish, nearly transparent threads, microscopically small, which ramify in all directions through the tissues at whose expense the fungus is growing. The interior of any of the cells, when examined through the microscope, shows plainly these branching, ramifying threads. The swelling, which gives the name "knot" or "wart," is due, undoubtedly, to an abnormal stimulation of the branch by the fungus growing into it. The cells of the young wood, which are the active, living cells of the branch, increase and multiply very largely, and you have a large, stout, succulent knot in the early stages. That knot becomes a mere shell later. That is due, not to the action of the fungus at all, but to a secondary cause, — the attacks of an insect which finds suitable food in the swollen, juicy, succulent tissues of the knot. But in the early stages of the knot, before it is attacked by the insect, you will find a juicy, sappy mass produced by the rapid increase locally of the cells of the young wood and the inner bark, caused by the abnormal stimulation and development produced by the presence of the fungus in the tissues. Finally, along in early summer, the threads of the fungus penetrate and work their way through the surface of the knot, and their ends stick out all over it, forming a sort of bloom, in appearance to the naked eye very much like the natural bloom of the plum fruit. That bloom is composed, as I have said, of the ends of the fungus threads, which have penetrated the surface of the knot and stand closely packed together all over that surface, like the pile of velvet plush, on a microscopically small scale; and a little piece of that end gets chopped off, and there is a new spore. That spore, although it is simply the chopped-off end of one of those threads, has the power of producing a new fungus, if it falls in a suitable place, under suitable circumstances of moisture and warmth. These we may call the summer spores. The fungus also produces, as Dr. Fisher says, a second kind of spores, which we may call winter spores. These spores do not get ripe and ready for dissemination until about February or March, and then the threads are formed, not on the surface, like the summer spores, but in the little cavities. By the time they are formed, the juicy interior of the knot has been largely eaten away, and there remains a black crust or scab over almost the entire surface, which may be readily broken down by pressure, on account of the almost entire absence of any solid substance beneath, due to the borings of the insect which attacks it. But, if this crust be examined by the naked eye, or with the aid of a hand lens which magnifies a little, it may be seen that it is filled with little cavities; and an examination of those cavities would show little elongated sacs, in each of which are eight winter spores. Now, when the spores become fully ripe, they escape through these cavities into the air and are carried about, as I have said, by the wind, by very light currents of air, because they are so very small and light; and finally, if they fall where there is considerable moisture, which is usually needed, they propagate the disease in a new place. It is probable that they do not, as a rule, germinate very rapidly, — probably not until some of the warmth of spring comes, although they can stand a pretty cold temperature.

In these two ways — by the quick germinating and superficially produced summer spores, and by the internally produced and more slowly germinating winter spores — the fungus is propagated and spread. The only remedy that we know now is that which has been mentioned, — of cutting. It is a shame that such a pesky little thing as the black-knot fungus should get the upper hand of us as it has done. It should call for less heroic treatment.

Of course this whole subject of plant diseases and vegetable pathology is a new one. It is a field which has not been very much worked. The economic, practical side of it is one which has been very little worked, because there have not been many people who have had an opportunity to do it. Many of the experiment stations are offering to some of us who are fond of that kind of work, and want to do it, opportunities to do it; and we are going to do our best to turn out results. Of course work of this kind is extremely slow. There are hardly more than a dozen men in the country who are engaged in that kind of work, and of course that number of men will not make rapid progress; but we hope to make steady gains, take up one thing after another, and get something more out of it than we know now. In this black-knot question there is work for one man for half a life-time, almost.

Dr. Fisher. I would like to make one suggestion arising out of the remarks of Professor Humphrey. Cut out the black-knot before you see the bloom in the summer, and in the winter cut out the black-knot before February.

Adjourned to quarter past one.

AFTERNOON SESSION.

The meeting was called to order at 1.30.

The CHAIRMAN. The lecture this afternoon will be by a gentleman whose name is almost a household word in every rural home in this land, as a practical and successful florist and market gardener for over forty years, and as an author whose name reaches far beyond the limits of this country; and, this being the first time that he has appeared before a New England audience, it gives me great pleasure to introduce Mr. Peter Henderson of New Jersey, who will address you on "Market Gardening as a Business."

MARKET GARDENING AS A BUSINESS.

BY PETER HENDERSON OF JERSEY CITY HEIGHTS, N. J.

Market gardening is not the profitable business it was twenty years ago, yet we have so simplified our operations of late years that even at the lower prices there is still a fair profit in the business, — certainly more than in ordinary farm crops. To many present the most that I can say about market gardening will be nothing new; but an experience of forty years in the business of actual practice and observation may enable me to tell some of the younger men a few things that may be of benefit.

There are thousands of farmers whose lands are near to the smaller towns, hotels, watering places and summer boarding-houses, where, if the farmer would devote a few acres to fruits or vegetables, or both, there is scarcely a doubt that it would be found that every acre so cultivated would be much more profitable than if devoted to ordinary farm crops. In most cases success would be proportioned to the quality of the land; but no one need hesitate to begin the cultivation of either fruit or vegetable crops on any soil that will raise a good crop of corn, hay or potatoes. The farmer, when he grows to supply a local demand, such as for hotels, boarding-houses, etc., has a great advantage in selling direct to the consumer. A few years ago an old friend told me of his unusual success in this line. His farm adjoined a village of two thousand inhabitants, which was to some extent a summer resort. He had one year a large surplus of strawberries and sweet corn, and had many applications for the fruit and corn by the village people. About three hours daily were used in delivering the products to his customers, and at such prices as paid him a clear profit of $175 per acre, which was five times as much as the average of his farm crops. In addition, the sale of the strawberries created an increased demand for cream, which was sold at higher prices in consequence.

I have said that the degree of success will usually be in proportion to the quality of the soil; so, when it can be done, select land that is level, and well drained by having a gravelly or sandy subsoil, and not less than ten inches in depth of good soil. If you are not a judge of soil, look around the neighborhood and observe the farm crops; if these are not strong and vigorous, rest assured that the soil is not such as will answer for market-garden work. Again, get as near to your market as possible, and see that the roads leading thereto are good. This is particularly important if your market is a large city like New York, Boston or Philadelphia; if you are growing for a local market, — supplying a small town at retail, — this is not so important. The business of market gardening, though healthful and fairly profitable, is exceedingly laborious, from which anyone not accustomed to manual labor would quickly shirk. The labor is not what might be called heavy, but the hours are long, — not less than an average of ten hours a day for both summer and winter. No one should engage in it after passing middle life, neither is it fitted for men of feeble constitution; for it is emphatically a business in which one has to rough it, and if it is to be prosecuted successfully, the owner must put his shoulder to the wheel at least as strongly as his roughest employee. The most successful market gardener I ever knew was John Riley. I put him as foreman in charge of my market gardens when he was but twenty-one years of age. In six years I sold him the place he had charge of, consisting of eight acres, two thousand sashes, horses, implements and crops, for twenty-one thousand dollars. He paid three thousand down (which he had saved from his wages and what I had paid him for boarding the men), and in three years paid off the mortgage of eighteen thousand dollars, solely from the profits gleaned from his eight acres and two thousand hot-bed sashes. This was in war times, however, when the profits were nearly four times what they are to-day; but Riley would have made market gardening a success almost under any circumstances. He was strictly methodical. He worked an average of eight men summer and winter, and, no matter what work was being done, whether inside or out, he worked the whole in solid phalanx, leading always himself. He was ignorant and uneducated, — could hardly write his name; but no Jersey market gardener ever made his mark so prominently as he.

The capital required for beginning market gardening in the vicinity of any large city should not be less than three hundred dollars per acre for anything less than ten acres. The first year rarely pays more than current expenses, and the capital of three hundred dollars per acre is all absorbed in horses, wagons, implements, sashes, manures, seeds, etc. If the capital is insufficient to procure these properly, the chances of success are correspondingly diminished. Above all, be careful not to attempt the cultivation of more land than your capital and experience can properly manage. More men are stranded, both on the farm and garden, in attempting to cultivate too much, perhaps, than from any other cause.

It has been the practice in the past to use hot-bed sashes almost exclusively for the purpose of forcing vegetables, or forwarding plants for use in the open ground. But of late years greenhouses are being largely used, both for the purposes of *forcing* lettuce, radishes, beets and cucumbers, as also for *growing* plants of early cabbage, cauliflower, lettuce, celery and tomatoes; and, in either case, we believe that in well-constructed greenhouses not only is the work better done, but that the saving in labor in three years will more than offset the greater cost of the greenhouses. We ourselves grow immense quantities of vegetable plants of all kinds, all of which are now started in greenhouses, in the following manner: We make our first sowing February 1, in our greenhouses, where the temperature will average about seventy degrees; that is, about sixty degrees at night, and about eighty degrees during the day. When there is not the convenience of a greenhouse, a hot-bed will answer the same purpose. A hot-bed, made with manure, about two feet deep, in a proper manner, produces just about the same temperature and general conditions as a well-appointed greenhouse will. We now invariably sow the seed in shallow boxes (those used in the importation of tin), which are one and three-fourths inches deep and about twenty inches long by fourteen wide. We use any light, rich soil for the purpose, sowing enough seed in each box to produce one thousand to fifteen hundred plants, or, if sown in the hot-bed, without the boxes, each three by six foot sash should grow about five thousand plants; but we find it more convenient to use the boxes than to sow in the soil, put direct on the bench of the greenhouse, or on the manure of the hot-bed. The plants sown on February 1, in a temperature averaging seventy degrees, will give plants fit to transplant in about three or four weeks. We then use the same kind of shallow boxes, putting in the bottom of each about three-fourths of an inch of *well-rotted* manure. Over that we place an inch of any ordinary rich light soil, smoothing it so as to have it as level as possible. In these boxes, which are fourteen by twenty inches, we put an average of about one hundred and fifty plants. After transplanting into the boxes, they are continued to be grown in the same temperature for about ten days; they are then placed in a temperature averaging fifty-five degrees, where they are allowed to remain for ten or twelve days, and finally are placed in cold-frames. The boxes should be placed as close to each other in the cold-frames as they will stand, — about eight boxes fill a sash, thus holding about twelve hundred plants. If the weather is cold, they are matted; if not, the sash will be sufficient protection. For the past five years we have each season grown about half a million of cabbage, cauliflower, celery and lettuce plants in this way, and have never failed to get fine plants, much superior to those raised by the old cold-frame plan of sowing in the fall.

Plants sown on the 1st of February are transplanted into the boxes about the 1st of March, and are fit to be placed in the cold-frames about March 10 or 15, and make fine plants to transplant to the open ground any time after the 1st of April, if they have been carefully attended to by watering, airing and protecting from frost. These dates refer particularly to the vicinity of New York City, where we can plant out usually in the open ground all kinds of cabbage, cauliflower and lettuce plants from April 1 to 10. If in districts where they cannot be planted out sooner than the end of April, then the sowing should not be made before the 15th of February; and the process of transplanting, etc., gone through as before stated, so that the plants will be in condition to plant in the open ground by the end of April. In sections where cabbage cannot be planted in the open ground before the 1st of May, the sowing should be delayed until nearly the 1st of March, and the process of transplanting in the boxes or frames the same.

Twenty-five years ago the market gardeners of New Jersey, mainly located in Hudson County, grew better vegetables than the Long Island men; but their limited area of land, getting less and less annually, in consequence of the inroads made by buildings, does not allow them to give their lands the needed relief of laying a portion yearly down to grass, so that their grounds have become actually surfeited with manure; and, for this reason, vegetables, such as cabbage, lettuce and celery, do not now average as good as those grown on Long Island, or other districts adjacent to New York, where the land is cheap enough to allow one-third to be put down annually with some grass or clover crop. I believe that, in a garden of fifteen acres, if one-third is laid down in grass each year, and the balance kept under the plough, the gross receipts will be greater and the profits more than if the whole fifteen acres were under tillage; for less labor would be required, and manure tells better on sod land than on land under tillage.

The subject of manure is one of never-failing interest to the gardener and farmer. I can tell you nothing new on the subject, except to say that the dried peat moss, now being used in the cities for bedding, is likely to be of great value to the market gardener, if it can only be had in sufficient quantities. We have had it in use in our own stables for about two years, and find it not only more economical than straw for bedding, but its absorbing qualities make it of great value for fertilizing purposes. We can buy ordinary straw manure in our vicinity for one dollar per team load; but we are buying all we can get from stables where the moss is used at two dollars per team load, believing it to be of twice the value of ordinary straw manure. It is claimed that the source of supply of the peat moss in Europe is almost inexhaustible, and it is now offered by three or four firms in New York, at prices ranging from twelve to fourteen dollars per ton, and it is hoped competition will bring it yet still lower. It is now used exclusively as bedding by some of our largest horse-car stables and express companies in New York and vicinity; and one of our largest livery stable men in Jersey City, who has been using it for two years, says he would rather use peat moss for bedding at fourteen dollars per ton than he would straw for nothing, so much more satisfactory does he find it in all respects for his horses. There are no doubt many swamps in the United States composed of peat moss, which may some day prove gold mines to their discoverers, as these deposits in Germany must now be proving to their owners.

The ordinary stable manure is yet used almost exclusively by the market gardeners of Hudson County, N. J., and that, too, at the rate of seventy-five tons to the acre. Very little phosphates or other concentrated manures are used on our lands, which are continually under tillage; these are always more telling on land broken up from sod, where the fibrous roots of the sod stand in lieu of stable manure.

The subject of market gardening is too large to attempt any detail of general culture; but I would advise all that intend engaging extensively in the business of market gardening to have greenhouses attached to the business to a greater or less extent; not only that they need never fail to give a good return for capital invested, whether for use in forcing vegetables, fruits or flowers, but, in addition, a matter of much importance is, that the labor of the workmen can be utilized as well in midwinter as in midsummer. This enables the employer to keep his hands all the year round, instead of having the annoyance of hiring inexperienced men when the work begins in spring. From my first beginning of the business, now over forty years ago, we have always used greenhouses in connection with our out-door gardens, and in consequence have been able to keep our old hands, at least twenty-five of whom have been with us from ten to thirty years. We pay these men nearly twice the wages of inexperienced workmen, and find it has paid to do so; for, in all the years we have been in business, we have never passed one where the balance has not been on the right side of the ledger.

The CHAIRMAN. I notice that there are quite a number of market gardeners in the audience, and Mr. Henderson will be glad to answer any questions that may be asked.

QUESTION. In relation to the growing of celery, are there any new varieties to take the place of the old ones?

Mr. HENDERSON. The best answer to all questions of that kind is to tell for what the demand comes. As seedsmen, we find that we are now selling more of the White Plume than any other variety. There are some sections where it may not do as well as some other variety; but we probably sell one-third more of White Plume than any other kind of celery seed. Of course a good deal depends on where your market is.

Now, the way you grow celery in Massachusetts is entirely different from the way we grow it in New York. You allow suckers to come up, and very sensibly, I think, sell it in that way; because the portions of celery where it branches with suckers are the most tender and the best eating. But we of New York have got into the habit of tearing all the side shoots off. We grow it coarser, and it does not branch so much. Therefore I say that varieties grown in one section may not answer in another. There is a variety known as the Golden Self-blanching that was introduced some two years ago, that, in sections where it will grow well, I think is one of the very best. It is shorter and specifically heavier than any other variety, but for some reason or other there is a weakness of constitution which prevents its growing in certain sections. In our section it does not grow at all; but I saw it growing about Binghamton, N. Y., last year, in a way that led me to think that, if we could grow it in the vicinity of New York in that way, we would grow nothing else. I think on some of your lands here it would be excellent.

Mr. PETERSON. I represent a district where there are large tracts of marsh land being reclaimed from the ocean. Have you any idea as to the probability of making asparagus and celery grow profitably on those lands, — marsh lands, which formerly produced nothing but salt hay?

Mr. HENDERSON. If sufficiently drained, and if you can get rid of the salt. You must get rid of salt from the soil. But the best test for any such crop as that is first to experiment with corn. If corn will grow, anything will grow; if corn will not grow, then you need not try anything else. Such land as you refer to would be just the very soil for asparagus, if you could get it clear of water and clear of salt. There is an impression abroad that salt is necessary for asparagus. I do not think it is necessary at all, and certainly neither asparagus nor anything else will grow if there is salt in the soil to any extent, because that is quickly fatal to all sorts of vegetable life.

Mr. HALL. I would like to inquire whether it would be necessary to put sand or fine gravel on that marsh land before celery or asparagus will grow there?

Mr. HENDERSON. I think not, sir. It does not make any difference what the crop is, — you must first get rid of the water. We have sections in the vicinity of Jersey City, the marshes leading from Jersey City to Newark, where thirty years ago they put up extensive works and pumped up the water from open drains; and they had the finest growth, I think, I ever saw of fruit and other trees. But for some reason they failed to continue the removal of water from the soil, and the whole thing died. In Lancashire, England, they have marshes, I presume, of the same character as those to which the gentleman has referred; and they have now steam pumps drawing water continually and removing it from the ditches, so that the water stands at least four feet below the surface of the soil, and in that way they get the best vegetable crops produced in England.

Mr. A. H. FITCH. Permit me to make a remark in answer to the question just asked in regard to marshes. I am familiar with the swamp lands of Kalamazoo, which perhaps is the place where the most celery is raised of any place in the United States. The bottom land between the bluff and the river is half a mile wide and is several miles long. Eight years ago it could be bought for from ten to fifty dollars an acre, within half a mile of the inhabited part of the city. To-day you could not get it for three hundred dollars an acre. It was an old cedar swamp. Through this run streams coming from the bluff, and ditches have been dug perhaps every forty rods or so; and by putting down planks a foot or two wide, you can dam the water back sufficiently to keep the celery well watered. Fields of thirty acres of celery are not uncommon there. Most of the land about Kalamazoo of that sort is appropriated to the growing of celery. That swamp land has been cleared of roots, and made so light that when you walk upon it it feels like an ash heap. It is so easy to cultivate, and so light, that it is exactly the place for raising celery.

QUESTION. I should like to inquire the best way to blanch celery.

Mr. HENDERSON. That question is one not very easy to answer, there are so many ways now. We adopt the old plan of planting it about four feet apart, and turning the soil against the plants on each side with the plough. By the way, they have a plough in Philadelphia made by the Planet Jr. Company of that city, that they say (I have not seen it) has lessened the work of planting celery to a wonderful extent, but it has not yet got to New York. When I speak of turning the soil with the plough, I refer to the first blanching, while the plant is growing out in the ground; but for the great mass that is grown in the winter we still adopt the plan of narrow trenches, putting it in about the width of from nine to twelve inches; and we trench to the depth of the height of the celery, and cover it up as the weather gets colder. In some sections of the country, particularly in the vicinity of Rochester, they are now getting large sheds especially adapted as houses for growing it in winter. I think that is probably a better plan. That is what we have adopted about New York, because, of course, there is always danger of a continued wet season destroying it when we put it in those open trenches, exposed to the weather. There is probably yet room for other improvements.

Question. How much frost will it stand without injury?

Mr. Henderson. That depends a good deal upon its condition. Celery that is grown in the open ground, say in this section of the country, if there has been no frost until about the 1st of November, nothing to temper it, would be destroyed probably by a temperature ten degrees below the freezing point; indeed, it is probable that five degrees below the freezing point, under certain conditions, would destroy it. But if it has been gradually tempered off by chilly nights and a temperature down to just approaching the freezing point, then it will stand fifteen degrees below that point. That is where the difficulty comes, in all these things. It is the condition of the plant that will determine how much frost it will stand.

Mr. Fitch. May I add a word in regard to blanching? There are two methods of raising this crop in Kalamazoo. In one the celery is planted in furrows, about five feet apart, and a foot deep. By and by it is filled up, and in the space between there is another row of celery set, so that they have two crops a year. There are two methods of blanching it. One is to crowd the celery together and press the earth up over it, and do it repeatedly, until you have it the desired length. The other method is, after you have earthed it up the first time, take boards twelve or fourteen inches wide, depending upon the growth of the plant, and set them close to the celery and stake them up. It is a rather expensive method, but some think it a better way. When I was there three years ago, I found that one person was trying something like drain tiles especially made for the purpose. I have not learned what his success was. As you may well imagine, it requires an immense amount of toil to do it, because the tile as well as the boards will take up much room, and cost a great deal of money.

Mr. W. W. Rawson of Arlington. I think the gentleman has made a mistake in regard to the extent of the territory in Kalamazoo that is covered with celery. I think it is about three hundred acres. I was there about two years ago, and I found that many of the celery growers preferred blanching the celery with loam instead of using boards. As far as self-blanching celery is concerned, I do not believe there is any such thing. It is not fit to eat until after it has been loamed up. You may call it "self-blanching," or anything you please. With regard to the variety of which the lecturer says he sells so much, of course he will sell more of it than any one else. He being the originator of it, the rest of the seedsmen would send to him for it; hence his larger demand for that than for any other variety. But in this part of the country we use the Boston Market, Arlington, and Paris Golden. This latter is the celery that has been referred to by one gentleman. It has only been introduced into this section about two years. I think the first that I saw in the market here was year before last. This last year it was grown quite extensively, and to those who grew it it was quite profitable. I do not know what will happen next year, but the demand for seed is very large.

In reference to the amount of capital which the lecturer spoke of as necessary to carry on a market garden of ten acres, he perhaps stated it rather mildly when he said three hundred dollars. That is not enough. Five hundred dollars per acre is little enough for anything in the vicinity of Boston. And as regards hot-houses, they are, of course, useful in the spring of the year, but they can be used to better advantage in the winter season. He also spoke of manures. This is quite an item with us here in New England. We purchase manure from stables in Boston, using it for heating purposes mostly before it is placed upon the land; that is, placing it in the hot-beds, where some of us have two or three thousand sashes. It takes a large quantity of manure for that number of sashes, — a cord to eight sashes. The price of manure here is about the same as in New York. They have commenced using peat to some extent in the stables in Boston, and a representative of a peat concern came on here some two years ago to introduce it; but he found that he could sell but very little peat in Boston, for the reason that the farmers would not take the manure from stables where peat was used, because they wanted it for heating purposes.

With reference to the other parts of the lecture, I can concur with the lecturer in every instance ; but I think in most cases it will depend about as much upon the man as it will upon anything else that you have. That is, the man must know his business, especially in these days. It would do very well in war time for any of us to plant what we pleased, there was a profit in it every time ; but things have changed. There is not a profit in everything you can put in the ground. I have had a large experience, and I find that the older I become the more I have to grow, and the less the profit seems to be.

Mr. KINNEY. I do not know but the celery question is assuming too large proportions ; but, being engaged in market gardening in the vicinity of the small city of Worcester, and knowing that almost all the celery furnished that city comes from Kalamazoo, it seems to me that it is about time we knew how to grow it. I think I have grown more White Plume celery than any one else in Massachusetts, — I know I have grown more than any one else in Worcester ; and I have never got half enough to supply the demand. The more I have, the more I want. Some of the best hotels in Worcester will not take anything else if they can get that. The Arlington and the Boston Market go a-begging if they can find the White Plume. There are a good many reasons why the White Plume is better than any other celery. It looks better. Now, there are very few people who care to eat celery, but many people like to look at the handsome leaves of the White Plume. When the Kalamazoo people can grow their celery and send it to us with the leaves intact, then they will have something that will be a great improvement on what they send us now. I do not think it makes very much difference whether a man raises anything which is good to eat, or not. If it looks well, it will pay him to raise it ; and if it looks well, he will take all the premiums wherever he exhibits it, whether it is good or not, — it may be potatoes, it may be celery, it may be squashes, or anything else. I am sorry it is so.

We are not discussing small fruits, but I may speak about the strawberry. Years ago, in New York City, I saw a pint of strawberries, and inquired the price. I sat down and counted my money, and decided that I should have enough to carry me home if I bought the strawberries. I bought them because they looked so handsome. They were the Jucunda. I did not think they were very good. I inquired where they came from, and I found they had traveled five hundred miles by rail, and had been on exhibition two days before I saw them. I made up my mind that was what I wanted to grow; and I began to grow Jucunda strawberries. Now, it was not because they were good that I could sell them for seventy-five cents a quart when others only brought thirty or forty, but because they were handsome. That is the reason the White Plume will sell, and does sell. Now, I want to know how we can keep it and sell it in winter, after Thanksgiving. It is delicate, and we cannot keep it.

Mr. Henderson. The gentleman is entirely mistaken about that. We keep the White Plume as long as we keep anything else. You will find plenty of White Plume celery in the New York market in February and March. In regard to the new Golden Self-Blanching, which is a sport from the old Sandringham, I think it is the best celery extant to-day, in places where it will grow, because it is much more solid than anything that I know of among the older celeries; and, as far as ornamentation goes, this Golden Self-Blanching is almost equal to the White Plume. That, coupled with the fact that it is much more solid and of better flavor, I think will make it *the* celery in the future.

Question. I would like to ask the lecturer how he keeps it.

Mr. Henderson. Simply trench it in the usual way. There is one thing in keeping celery that is of vast importance to understand. It must be put in the trenches as late as you can possibly get it in.. In my district they begin putting it away about the first of November, and do not finish until about the end of November. They sometimes get caught by frost, but not often. Then you must run the risk of keeping one-third of the crop out, with the expectation that the frost will not touch it, and thereby getting it late. Before celery blanches, the first thing it does is to root; and if the temperature is low when it is put away, it does not form roots, and consequently stays in the condition in which it is put in until the season comes round for it to root and grow and blanch. Sometimes they will even bank it up and put it away in those narrow trenches, with the object of keeping it late. But I have not the least doubt that, if proper houses are made, as is the case in the vicinity of Rochester, it can be kept as late as any other variety.

Mr. Howland. I want to ask a question in regard to growing asparagus. I have a bed of asparagus that I have fed with nothing but commercial fertilizers since it was set. I have read in the writings of prominent market gardeners in this country that asparagus can be made to thrive and produce a large crop with no other fertilizer than nitrate of soda. My bed is prepared with a compound made of dissolved bone, potash and nitrate of soda, — a thousand pounds of bone, five hundred of potash, and five hundred of nitrate of soda. I do not see but it has done as well as a bed close by it, that has been fed with stable manure. Now, the question I would like to ask the speaker is, if he has ever had any experience that enables him to say whether or not asparagus will thrive and yield as large crops if fed with nitrate of soda alone as with a complete manure, — commercial fertilizers or stable manure?

Mr. Henderson. I cannot answer that question. I have had no experience with nitrate of soda.

Secretary Sessions. Cannot Mr. Hersey answer that question?

Mr. Hersey. I have never tried nitrate of soda alone, and cannot answer the question. From other experiments tried on other crops, I should very much doubt whether it would be a good plan to use nothing but nitrate of soda. But asparagus can be grown successfully many years, I know, with commercial fertilizers alone. I think it can be grown better than by the use of barn manure. I am quite satisfied that it is better to feed with commercial fertilizers than to depend on barn manure; and I am also quite certain that the cost will not be much more than one-half.

Mr. Howland. An eminent authority has stated that nitrate of soda was sufficient for a good crop of asparagus. It seems to me it is worth while for farmers who grow that vegetable to ascertain whether that statement is true, or not. He also recommends it as an excellent fertilizer for celery, used alone. He puts the matter rather strong. He says he tried it with success. It seems to me it would be well for us to test it.

Mr. HERSEY. I would say that I tried an experiment one year on asparagus with nitrogen, and I could not see that it increased the crop at all. I could not see that there was any larger crop that year or that there has been since, where it was put on than where it was not. Of course it might be owing to the condition of my soil. I think that every farmer and every gardener has got to understand his own soil before he can fertilize it to the best advantage. There may be soils where nitrogen would be just the material that was needed, and then there may be other soils where it will do no good at all. I do not think that you can lay down rules by which you can instruct farmers as to the best thing that they can put on any particular crop. I think that we have got to manage our farms practically, by the wisdom which we gain for ourselves. I think that we must keep our eyes open and watch carefully all of the operations on our farms, and learn by our own experiments what is best for us. I do not think that we can settle anything here in regard to the application of any particular fertilizers on any particular soil that we know nothing about.

The CHAIRMAN. I would like to inquire if there is any gentleman present who has had any experience with the application of nitrogen in the form of nitrate of soda, or in any form, in the cultivation of asparagus or celery. I will call on volunteers. If there is any gentleman present who has had any experience in that matter, let him stand up and declare himself. Now is a good time.

Secretary SESSIONS. I hope no gentleman will be bashful if he has ever had any such experience, because it is an important point.

Mr. PETERSON. Nitrogen is supposed to be productive largely of stalk and leaf, and not so much of seed. In one instance I had a piece of oats which produced a most remarkable crop, and it was attributed to the fact that the fertilizer applied was composed mostly of nitrogen. I cannot speak from any scientific knowledge, only from observation; but the crop was so heavy on that little piece of land where nothing but that material was put on, that it took two of us to clear the oats away from the mowing machine when they were cut down.

Mr. LYMAN. In using nitrate of soda, you will, if you are not very careful, be likely to injure the crop. That is especially so with celery and also with asparagus. It seems to cause the celery to grow hollow. You must be very careful not to use too much.

Mr. SAMUEL WHEELER. I have had some experience in the use of nitrate of soda on small fruits, and I have used it on asparagus a little, — not, however, entirely alone. I find it is something that must be used very judiciously, and, as Mr. Hersey has stated, we must use our own intelligence, our own thoughts, in the application of it. I think if very many tried to apply it to lettuce or any small vegetable like that, they would be very apt to make a mistake. In regard to the use of commercial fertilizers on asparagus, there is under my observation a piece that has been set out perhaps for half a dozen years; nothing but commercial fertilizers has been used on this piece; it is growing better from year to year, and the parties who own it have been very much pleased and satisfied with the results obtained from the use of those fertilizers. I have not grown asparagus very largely, but I have a small piece on which I discontinued the use of barnyard manure some number of years ago, and that piece has had, in addition to commercial fertilizers, nitrate of soda applied; and I cannot see any difference from year to year when that is put on as a partial fertilizer instead of the fertilizers compounded for that purpose, having all the ingredients in one. I will say that the piece has continued to increase in productiveness for the last number of years, and I will also state that we have had the name of sending in some of the very best asparagus that has been sent to the commission house where we have sent ours.

Mr. AUGUR. One word in regard to the use of nitrate of soda on strawberries. I can emphasize the remark which was made respecting the need of caution. We made an application one year of nitrate of soda, and to our very great detriment. We could see that it did damage as far as it was applied. I suppose we applied too much. I merely mention this to show that those who attempt to use it should use it with very great caution.

Question. I would like to ask the gentleman the formula which he uses for asparagus, and the time of application?

Mr. Wheeler. We commenced using the Stockbridge fertilizer especially prepared for asparagus, and used that for one or two years. For the last two years I think we have used the Bay State, manufactured by Tucker & Co. of Boston. We apply it in the spring. I think we have put on at the rate of fifteen or sixteen hundred pounds to the acre.

Question. How many applications?

Mr. Wheeler. Only one application. We like it very much better than we do barnyard manure, because it leaves the ground free from lumps or any impediment to the coming up of the asparagus. We get stouter and better shoots than we do when barnyard manure is applied.

Mr. Jefts of Ashby. I find that nitrogen in some cases makes a good show, in others no show at all. If there is sufficient nitrogen in the land itself, we cannot expect any result from the use of nitrate of soda. I remember two years ago trying to raise potatoes with nitrate of soda alone. The soil was worn out, and of course I raised no potatoes. That same year I tried potash and phosphoric acid, with the same result. I tried nitrogen and phosphoric acid, with the same result, — no potatoes to speak of. I put the three together, thus getting everything that was wanted by the soil, and then I got a good crop of potatoes.

Mr. Howland. I will state that one bed of asparagus which I have has had nothing but commercial fertilizers upon it for twelve years, and the crop does not seem to depreciate in size or quality. I find this advantage, together with others which the gentleman spoke of who preceded me, that, besides the absence of lumps and having the soil in much better condition, we have very many less weeds, which is quite an item. The fact that this bed of mine, which has been set twelve years, succeeds, together with the fact that the soil is in good condition and we have less weeds to fight, etc., is certainly a recommendation to me of commercial fertilizers for asparagus as well as for a good many other things, for the very same reasons.

The CHAIRMAN. I would like to inquire of Mr. Haslam if he has had any experience in the use of nitrate of soda?

Mr. HASLAM. I have been raising asparagus for thirty years, and have now nine acres. I have raised it with all kinds of fertilizers, — commercial fertilizers, barnyard manure, etc. What I am using at the present time is one-half mixed commercial fertilizers and the other half bone, nitrate of soda and potash or ashes. My reason for using those materials is this. The result for the next year with asparagus depends on the growth you get after you get through cutting this year. For the first month no fertilizer has anything to do with it. You can take half an acre with no fertilizer upon it, and another half acre with fertilizers upon it, and the result will be just the same up to about the first of June; after that your fertilizer becomes soluble, and your crop begins feeding upon it. I put on some of the fertilizers in a soluble form, so that the crop can take them up. I put on the other, so that after I get through cutting it will be soluble and furnish food for the asparagus. That is the idea I have, and I think I obtain the best results in that way. I tried a few rows with clear nitrate of soda, and I saw no different results from it than where I applied nothing but ground bone. But I think, as has been said here, that a combination is needed. You analyze asparagus, and you will ascertain just what it needs; and you want to give it a little more than what the analysis requires. A friend of mine who has an asparagus bed sent to Amherst to learn what was needed for a crop of asparagus. The formula furnished was two hundred pounds of bone-black, five hundred pounds of ground bone, and I think about a hundred pounds of muriate of potash. The gentleman tried it, and he tried just twice that amount on a part of the bed, and he found that he got a good deal better asparagus with the larger amount. I use a ton and a half to the acre, and I think I get well paid for it.

Mr. PAUL of Dighton. I have experimented a little with nitrate of soda upon strawberries. I used it two years, and I am satisfied that upon strawberries on my land it did no good. A neighbor of mine is raising spinach to some extent. He has used various applications, and finds nothing that gives such results in proportion to the expenditure as nitrate of soda applied in the spring of the year for an early growth.

Secretary SESSIONS. Is not that true, Mr. Paul, of dandelions also?

Mr. PAUL. I am not certain whether he has tried it upon dandelions, or not; I presume it may be so.

Mr. ——. If you will allow me a moment, I would like to say, as one who has had more than ten years' experience in the manufacture of fertilizers, that the success or failure of any particular fertilizer depends materially upon the previous methods of cropping, as Mr. Hersey has told us, to whose opinions we all listen with great respect, and also on the previous methods of fertilizing the soil. I think we can profitably spend a few moments in listening to the views of the lecturer on the selection and use of fertilizers.

Mr. HENDERSON. We have had very little to do with commercial fertilizers. Our whole operations in Hudson County have been on land for which we pay a hundred dollars an acre per annum; consequently, every foot is tilled, and we find that the necessity comes for stable manure. We try if possible to get a mixture of cow and horse manure. Since we have been using this peat moss we have gone around to the livery stables from which we get our manure, and made the stable men sprinkle over the bedding each day just about as much bone-dust as you would put of sawdust on a floor, and in that way we get it in a condition suitable for the plants to take up when we get it on the soil. The longer my experience in gardening matters has been, the more I am satisfied that the great object is to get the commercial fertilizers, such as bone-dust, in a condition to be taken up by the roots of plants. Now, I am an extensive grower of roses. We used to think that we could take bone-dust and sow it over our beds or bunches of roses, and get good results. We find that practically it gives hardly any results; and we now use about four parts of loam, one part of cow manure, and about one-thirtieth part of bone-dust, for the soil that we use to grow our roses in. It makes hardly any difference whether it is roses or roots or what the article is you are going to force, you want about the same kind of soil. We keep this compound heaped up at least twelve months before we want to use it, and then it is in the best condition to be taken up by the plants. We find that the result has been something wonderful, compared with the practice that we used to follow of using the fertilizers when we put in the soil. It takes twelve months for these fertilizers to decompose in the soil before we use it, and that I think can be carried through the whole catalogue of manures. If we use stable manure, it will be always best to use it in connection with a commercial fertilizer, and thus get the mechanical effect of the stable manure and the nutritive effect of the fertilizer at the same time.

QUESTION. Do I understand that it would be better to mix the ground bone with the manure this winter for next spring's crop?

Mr. HENDERSON. Yes, sir. I wish to say, in regard to using this peat moss to which I referred, that it would be used in the ordinary way with cow manure; and I think such manure is much better with peat moss, because that is such an absorbent of everything connected with manure. We sow this bone-dust, or whatever concentrated fertilizer we use, on the bedding, and it is absorbed and mixed with the manure and thrown into the heap in the usual way.

Mr. EDSON. I would like to ask the lecturer if he has had any experience with the asparagus beetle. I find it much easier to raise asparagus than it is to keep it from the beetle.

Mr. HENDERSON. I have had no experience with it. I am glad to say the beetle does not trouble the asparagus in our vicinity.

The CHAIRMAN. Has Mr. Hersey had any experience with the beetle?

Mr. HERSEY. I have had all the experience with him that I care about having. He has been on my farm for the last five years, but I have got a little used to him. I suppose what is wanted is to know what is the remedy, for we all know he is very destructive. But that question is one which I hardly feel able to answer. It is said that Paris green will kill him, but for some reason or other it will not kill him on my soil. I think he grows just as well when the plants are covered with Paris green as he does when they are not. London purple is undoubtedly preferable to Paris green, as it sticks to the plants better; but I have had greater success in killing him with pulverized lime than with anything else. I use air-slacked lime, but I believe it is generally understood that unslacked lime is the best. I have my doubts, however, about that. The slug of the beetle is a sticky thing, and if any dry substance can be made to stick to him (and almost anything will that touches him), it is pretty sure death. I think he is killed by putting a little of this fine lime on him, just the same as the currant worm is killed. The currant worm when small can be killed with ashes or with lime in the same way, by its sticking on its body. I think that is the reason why lime is better than Paris green; it sticks on the outside of the bug, and kills him. There is more difficulty in taking care of a bed that is not cut than there is of one that is cut. If you have young asparagus on your place, the beetles will get on in large numbers. They will leave an old bed entirely, and go to the new bed. Then, if you cut the asparagus on the new bed, the beetle goes back to the old bed; he wants to be on the young growing plants. One year I did a thing that I think was the best I ever did. I had a large asparagus bed, of perhaps fifty thousand plants; and just after I cut my asparagus I mowed it down close to the ground and burned it off, and the beetles with it. That thinned them out so much that they did not trouble me again for a number of years. But I have been induced to plant new beds within a year or two, and I have suffered more from the beetle this last year than I have for several years before. When you cut your bed up to the 20th of June you get clear of the bugs, so that there will be very few, if any, carried over; but when they are thick in the spring, after you have cut your crop, they are carried over through the winter, and the next year you will find that they will injure your crop very much by eating the buds. They will be so thick that they will eat off the tops of the buds before they get high enough to cut. I know of no remedy. Of course it will not do to put on any poison; it will not do even to put on fine lime. That is one of those questions which are coming up every year, as to what we shall do to conquer the creeping things of the earth. Sometimes it seems as if they were going to conquer us, but then we find a remedy, and something else comes in; so I suppose they are going to keep on coming, and thus we have got to grow wiser and wiser if we would succeed in our agricultural projects.

Mr. Stone of Watertown. It was said by Mr. Henderson that asparagus does not require salt. I think that five out of ten men use salt. I know the best asparagus bed I ever saw in my life is a bed which belongs to one of my neighbors, and that bed has not had a spoonful of manure or any kind of fertilizer whatever for ten years except salt. That bed, which occupies an acre and a quarter, has netted not less than four hundred dollars a year, and from that to six hundred. The owner says he would not take the trouble to give it a coat of manure if you would give him the manure. The salt not only does the work of fertilizers, but it keeps the weeds down; and it is the cleanest bed that I have known of for years, it produces the largest stalks, and is the best paying bed that I have seen in the town.

Mr. Henderson. I think the gentleman will have to look to some other cause. The reason why I am so positive in the belief that salt is no benefit to asparagus, is the fact that asparagus beds grown in the vicinity of New York Bay, where the whole atmosphere is impregnated with salt, give us no better crops than inland, where there is no salt spray whatever, and yet the beds are not treated with salt. I live about half a mile from the bay, and on moist days you can feel the salt on your lips; and yet asparagus grown there is certainly no better than it is twelve miles inland. I have examined the question very thoroughly, and while this is, of course, negative evidence, still, there is the fact that where the atmosphere and soil are impregnated with salt there is no apparent benefit to asparagus, or, in fact, to anything else.

Mr. Hersey. I do not like to occupy so much of the time, but this question is of importance, and as I have had positive practical experience in this matter, I feel that I should be doing injustice if I did not give it. When I commenced raising asparagus, forty years ago, I thought I must do as the books said, and so I began to raise asparagus with salt; but, always wishing to know from my own practical knowledge what was best, I began experimenting. So I raised side by side asparagus with salt and asparagus without salt, and it took but a very few years to settle to my satisfaction that the salt was of no possible use, but rather a damage, to the asparagus. It was a damage to its size, it was a damage to its flavor. I carried asparagus into Boston that had been raised without the use of salt, and got three or four cents a bunch more for it than those who carried in asparagus raised with salt. I have raised asparagus without salt an inch and five-eighths in diameter, and that is big enough; you do not need to grow it any larger than that. I feel as sure that salt is of no use on my land for asparagus as I am that I stand here to-day; but I am not going to say that there may not be a spot upon this earth where salt may be beneficial to asparagus. It may be so, and if there is one man who has found out that he has a piece of land that can be manured with salt, why, he would be a fool if he did not use it.

Professor Stockbridge. I have the impression that these different opinions about the use of salt can be reconciled. Our friend the lecturer, whose land is down by New York Bay, where the air is so full of salt that in an ordinary day he can feel it upon his lips, must know that his soil is full of salt. What does he want of any more to grow asparagus? My friend Mr. Hersey lives down in Hingham, where the sea breezes are blowing salt all over him and all over his asparagus beds. What in the world does he want to use salt for? Now, I should like to have the gentleman who has told us about that asparagus bed which has grown such splendid crops for ten years with salt alone, state where it is.

Mr. Stone. It is in Watertown, four miles and a half from Boston.

Professor STOCKBRIDGE. Then that illustrates the old saying, that what is one man's meat is another man's poison.

Mr. PETERSON. I would suggest that possibly some of these articles mentioned may have a mechanical effect upon the soil. Salt may have some mechanical effect as a mineral in the soil, and that may account for the results which have been described. I know that the application of beach sand, which I made at the suggestion of Professor Goessmann, has given me better results than if I had applied a dressing of manure. My point is this: that any common sand applied to low and heavy soil acts mechanically, and elaborates the plant food which is in the earth and which is essential to the growth of plants. I do not know much about salt. I live within five minutes' walk of a beach, and I have no difficulty in growing anything after a little experience; but some things have baffled and vexed me until I have gained a knowledge of their nature, and then I have generally succeeded. Cabbages, especially, I can grow right on the borders of a salt-marsh; and I get splendid crops of cauliflower.

Mr. RAWSON. I wish the lecturer, he being very familiar with cauliflower seeds, would describe the different kinds of cauliflower and their growth, particularly on Long Island.

Mr. HENDERSON. The Algiers, the Erfurt and the Snowball have been almost exclusively used in our locality. The Algiers has been grown almost entirely for a late crop on Long Island; but it has failed so completely for the last two or three years that they are now using the Snowball and Erfurt instead, using the early varieties for the late crops. These are the only kinds that are now used in our vicinity.

Dr. FISHER. If the gentlemen will bear with me a moment, I should like to introduce the antidote along with the poison. The poison seems to have taken hold pretty strongly. People are talking here about raising plants with nitrate of soda, raising plants with salt. It cannot be done. It is pure nonsense. Plants do not feed on salt, they do not live on nitrate of soda. You might just as well say that because a man uses pepper with his dinner, you will feed him for the next week on pepper. Pepper is good for him, therefore feed him on pepper! It would be just as sensible as it is to talk about feeding plants with salt, or even with nitrate of soda. What is nitrate of soda? It is a single constituent. What is a plant? It is made up of a dozen or twenty. Will one constituent take the place of twenty? By no manner of means. You have got to furnish to the plant all those things which the plant needs, and it is nonsense to talk of furnishing one of them to the exclusion of the others. There are three things that plants especially call for in larger quantities than soils furnish. There are three principal constituents which plants of all kinds require more than any others. Those are potash, phosphoric acid and nitrogen. Those are the three things which plants feed upon. Nitrate of soda does not contain them; ground bone does not contain them; ashes do not contain them. You have got to give your plants all three, in order to have healthy, thriving, successful plants; and it is nonsense to talk about furnishing any one of them with the idea that it is going to produce a plant. What is the use of nitrate of soda? Plants that have not nitrogen in them will be benefited by the application of nitrogen in the form of nitrate of soda. The soda itself is of very little use; it is merely the vehicle in which the nitrogen is conveyed. The object, as I take it, of applying nitrate of soda to any of the early crops, is this. If you feed them with barnyard manure, for instance, there is not enough of that barnyard manure soluble in the spring to feed the plants, especially there is not enough of nitrogen; and if you give them a little nitrate of soda in addition, it is all very well. The idea that nitrate of soda of itself is going to grow a crop, is nonsense. It is only one of the constituents that contribute to the making of your crop. There are some special things, like sand, that will in some cases favor the production of a crop on account of the mechanical condition into which they put the land. But there is no nourishment in sand, no nourishment in salt. You must furnish everything that the plant needs, and especially those three things which experience has found to be necessary beyond what the soil furnishes.

Secretary Sessions. If the soil is richer in one of those ingredients than in the others, a special application of those in which it is deficient may be of profit. Ought we not, therefore, to find out the condition of the soil in that regard?

Dr. Fisher. I think it is a waste of time to expend it in that direction. If I have a merino mill and want to produce some merino goods, I do not ask whether there is some material stored away perhaps in one of the back rooms of my factory, but I furnish the cotton and wool and make my goods. If I want to produce a thousand yards of merino, I must furnish to that factory the complement of cotton and wool to make it with. If my factory happens to have a lot of cotton on hand, it does not influence me at all, and it does not influence me on my land. I do not ask my land anything about it.

Secretary Sessions. I do not believe that the doctor, if he had plenty of cotton in his mill, would go to the expense of duplicating the cotton as well as buying the wool. That is the point I wish to make.

Dr. Fisher. I might not do it for one year. Suppose you had a quantity of cotton on hand; you would furnish wool enough to go with it, but you would not expect your mill was going to furnish you every year with that amount of cotton. That is the principle.

Secretary Sessions. No, not at all.

Dr. Fisher. A man experiments a little, and concludes that his land does not want potash, and he never applies any more potash in the whole course of his life. That is all a mistake. Furnish to every plant just what the plant needs, and call the soil nothing but the mere shell in which the work is done.

Mr. Paul. There is one very practical point with which those who are cultivating asparagus have to deal, and that is the beetle. The asparagus beetle appeared early at the South, and worked its way into south-eastern Massachusetts. It appeared there a year before it was found in the vicinity of Boston. I have a field of two acres, and the beetles came into that field, and I had a great deal of trouble with them. I think I expended one year in labor, and about a hundred dollars in the purchase of remedies, in trying to check them. There was no application that could be made to the asparagus that would kill them. I tried various things which did not seem to have any effect at all, because their method of feeding was different from that of the beetles that we had been accustomed to. I supposed at one time that I should have to plough up the field. I finally conceived the idea of turning my fowls, of which I sometimes keep quite a number, into that field, after I got through cutting the asparagus. I put probably seventy or eighty hens, with as many or more chickens, into the field. They gave the beetle a check, and from that time forward I have followed the same practice every year, and have had very little trouble with the beetle. My impression is, that if asparagus growers will inclose their fields and put their fowls in after cutting, they will find no difficulty in dealing with them. Otherwise, if they attempt to deal with them in the ordinary way, it will be many years before they can be checked. I have watched the habit of the beetle enough to understand that in a short time after it appears a parasite also appears. In new sections where it appears it goes ahead of the parasite; and if you can check it until the parasite makes its appearance, you will have no difficulty. I cut everything I can during the period of cutting, whether it is small or large, so that the beetle will have no food. A large majority of these insects lay their eggs and disappear before we get through cutting, but very many of them remain to propagate their kind later. I am very well satisfied — more so in regard to this than almost any other point that I have had experience with in farming — that by following the course I have suggested the beetle can be checked.

Mr. W. H. Teele of Acton. The asparagus beetles came to my bed about three years ago, and they increased very rapidly last year. I made up my mind that something must be done. I tried Paris green last year, I tried air-slacked lime, I tried clear lime, and neither did any good. Then I thought my application of the Paris green was wrong. Of course I tried putting it on by hand, and I wanted to find some way by which I could put it on and not have it cost me much. So I told my boy to go and get the horse, and I took two barrels of water out to the bed. I have two watering-pots with fine nozzles that I use to sprinkle my potatoes with; and after mixing Paris green with the water, I sprinkled the asparagus beds with the mixture, using those watering-pots, and the result of two applications was that I got rid of the beetles. Speaking of the parasite, I will say that I found a little bug, something like the lady-bug, on my asparagus, and I found that this was an enemy that was following the beetle. I think it will destroy it in the end.

Mr. Hall. I would like to ask Mr. Henderson if there is a method of putting lime on soil that is so clayey that after a heavy rain it bakes, so that that soil can be made permanently more friable.

Mr. Henderson. I cannot answer that question to my satisfaction, there are so many influences that might affect the soil which would prevent the action of the lime upon it. I do not think that any special rule can be given. In practice we prefer to use lime on heavy soils, but I must confess to a good deal of ignorance in the matter.

Mr. Hall. How is it generally used?

Mr. Henderson. It is generally used on heavy soils rather than on light soils.

Mr. Hall. I would say that I was recommended within a few days to put the lime out in little piles in the fall, cover it with soil, and let it remain there until spring and then spread it.

Mr. Henderson. I should say that that would be a very sensible method of doing it, but I have had no large experience with it.

Mr. Augur. Professor Storer of your State, who perhaps is as good authority as can be quoted, speaks very highly of the use of lime, particularly for clay soils, in making them more friable. I would like to say this. We have been very greatly troubled this year by mildew and grape rot, and I am going to try the effect of gas-lime, about ten or fifteen bushels per acre. I shall sow it this winter while the ground is bare, partly as an insecticide and partly for the benefit of the lime itself upon the soil. I tried it a few years ago with apparent success, and another vineyardist in our State has tried it repeatedly, and he regards it as a very excellent application, put on in the fall. There is quite an acrid character to it that seems prejudicial to growth; but, if applied moderately in the fall of the year, I think it will prevent the breeding of spores, and that the fruit will be better the succeeding year.

Secretary SESSIONS. Is it your pleasure to take note of the few questions that we have here, or do you wish to pursue the subject of market gardening still further?

In response to this question, there was a general call from the audience for "Questions."

Secretary SESSIONS. The first question is, "How can we rid our cucumbers, grown under glass, of lice?" I will call on Mr. Rawson to answer.

Mr. RAWSON. I cannot answer the question. I cannot do it myself, and therefore I cannot tell anybody else how to do it. I can get rid of them in hot-beds, but under glass I have not been able to do it. If there are any lice on them when they are put under glass, they will be pretty sure to stay there. The method of getting rid of them in a house is by very moderate smoking. We cannot smoke a house so strongly as we do for lettuce, because we would destroy the leaves and also destroy the cucumbers.

Secretary SESSIONS. Mr. Wood of West Newton can tell us something about boiling sulphur, which perhaps might apply here.

Mr. WOOD. If you ask that question with regard to keeping cucumbers free from vermin, I do not know that it has ever been attempted. I have used sulphur for the destruction of vermin under glass, more especially in the grapery, where I have had serious trouble with the red spider. It is well known that sulphur is the very best antidote for that insect, and at the same time it is a preventive of mildew. Those are the two troubles which we have had with our grapes grown under glass. I have also found it successful in destroying the thrip. I do not think it would be effectual in destroying the black or green aphis; but I have not had any difficulty in destroying them upon cucumbers by the use of tobacco. The cucumber plant will not stand so severe fumigation as some other plants; but when taken in season, and followed for two or three nights, I have never had any trouble in destroying them. Sulphur is a dangerous article to use, as you all know. The fumes of sulphur are fatal to all forms of life. I have used a porcelain dish, holding perhaps two quarts. I take a paper of the flour of sulphur, put it into that dish to the depth of perhaps an inch or an inch and a quarter, place it over the blaze of a lamp and boil as you would boil sugar; and so long as you keep a supply of water in the kettle there is no more danger in boiling it than there is in boiling so much water; but if you allow the water to evaporate and burn the dregs which will remain in the bottom of the kettle, you will destroy all the foliage in the house. Many who have tried it have met with mishaps in consequence of being careless. Or, if you attempt to boil it in a dish and do not take the proper precautions to prevent the flame from reaching it, the sulphur will ignite, and then you get fumes instead of vapor. But if care is taken in using it there is no more danger than in fumigating with tobacco, and it is entirely effectual in destroying the red spider and mildew.

QUESTION. Would not that method be more successful in killing poultry lice than anything else that could be employed?

Mr. HAWKINS. The best way is to burn the sulphur, but you must first drive out the hens.

Mr. WOOD. It is a practice among greenhouse people, when they have an opportunity to get their plants all out, to burn sulphur; then they get the fumes, which are fatal to all kinds of life, animal or plant. The object of using the vapor instead of the fumes is that we can use it where our plants are, and use it at all seasons of the year to combat two of the worst enemies that appear in our greenhouses under glass; that is, mildew and the red spider.

Secretary SESSIONS. The next question is, "Is there any remedy for the cabbage worm?" I would like to call on Dr. Cragin.

Dr. CRAGIN. My experience with the cabbage worm has been very limited. Whenever I have been called into contact with it, I have used black hellebore, pulverized. I use it also for the currant worm. I believe it is far more safe than many of the articles that have been used. I was conversing to-day with a gentleman who told me that he bought a cabbage at the market to put with the boiled dish which he was having, and it made all those who ate it very sick indeed. He did not know what was used on it. I have used hellebore for a number of years, and have never found any difficulty from it, — it may be that others have; but it stops the ravages of the cabbage worm wherever I have applied it, with only one application.

Secretary SESSIONS. You said, "black hellebore." Is that any different from the white hellebore?

Dr. CRAGIN. It comes in a paper. You can get it at most of the druggists'.

Secretary SESSIONS. Is it not white hellebore instead of black? Is not that the name of it?

Dr. CRAGIN. I have always called it black hellebore.

Secretary SESSIONS. I buy it as white hellebore. Can Mr. Augur give us any light on the cabbage worm question?

Mr. AUGUR. I can say that we have made brine strong enough to bear up an egg, and applied it with a sprinkler when the butterfly first appears, repeating it two or three times, and we have found that to be effectual. It will not injure the cabbage. The cabbage will stand it and seem to thrive under it.

Mr. HALL. I would like to ask if any one here has experimented to ascertain the difference between ploughing manure in and leaving it on the surface for the next year's crop?

Secretary SESSIONS. Mr. Hersey. He knows almost everything.

Mr. HERSEY. I know pretty near enough to know I don't know anything. I want to say that I tried that experiment some ten or fifteen years ago, when it was more the belief that manure lost a great deal of its substance by remaining on the surface through the winter than it is now. I took an oblong piece of land and manured it all alike. I took what we call kelp, sea-weed, which comes ashore on our beaches, — a material that most people believe loses three-quarters of its substance by lying on the surface, — and spread it on this land; and possibly a third was ploughed, two strips across it, in the fall, just as soon as the manure was spread; the other three strips were allowed to remain with the manure on the surface. The next spring the whole piece was ploughed. That gave two ploughings where the manure was ploughed under in the autumn. There was no perceptible difference in the crop, which was corn. It was so near alike that no one could see where the strips were. It was not measured accurately, but I got quite a number to examine it to see if they could tell where the manure was spread on the surface and where it was ploughed in at once. I have also tried other experiments in growing corn, by spreading the manure on in the autumn and allowing it to lie on the surface, and then spreading on the same amount in the spring by the side of it. When you do this there will be a difference of very nearly five bushels of corn to the acre more where the manure is spread in the autumn, over the crop on the land where it is spread in the spring. The land seems to change its nature, in a measure, where the manure is spread on the surface. I apprehend that this is because of the fact that the land is covered during the winter. As you well know, we are within five or six miles of the seashore, and we do not have the amount of snow which you have in the interior of the State; and therefore our land lies exposed a very considerable portion of the winter season, and no doubt some of the plant food is lost by being blown away; and where it is covered all winter the manure soaks into the land, so that when the corn comes up there is a larger quantity of fertilizing material that is available for the growth of the crop than would be available from that which is applied in the spring. I think there is where a portion of the gain is obtained. Of course the result will depend very much on the location. In the interior it may not make as much difference as it would with us, and possibly it might make more. I can only speak of the effect which it has had on my own soil. I am satisfied now that it is for my interest to cart out all the manure that I have and spread it on my land in the autumn, and also all that is made during the winter. Of course I would not spread it on a steep side-hill.

Mr. Rowley. I am one hundred and fifty miles from the sea-shore, and I wish to corroborate what Mr. Hersey has said in regard to spreading manure in the autumn, having had long experience both in spreading it in the autumn and in the spring. There is a very decided advantage in spreading manure in the autumn rather than in the spring, especially for the corn crop. The corn starts earlier and matures earlier; it seems to keep ahead the whole season. The land is lighter, does not get packed down as hard. I believe it is a matter of economy to take the manure out of the stable as fast as made, and spread it at all times of the year and let it remain on the land. I practice it through the winter. I would not put it on a side-hill, especially if the ground was frozen. I am hauling it out now, when the ground is not frozen, and I have never met with any loss, that I am aware of, by so doing.

Mr. Edson. I would like to say a few words in regard to that. In my practice I cart out all my dressing and put it on the land in the fall. I have practiced the other method, but I am fully satisfied that that is the best plan. If you haul out your manure in the fall and winter and put it on the ground, it goes into the sod and is ready for the corn when you reverse the sod. The liquid parts of the manure soak into the sod, and you get an early start of grass. Let it be until the 20th of May, or as late as you can, before you plough it, and then when you plough the sod under you have a crop of grass, which is a good fertilizer in itself. I find that corn planted under such circumstances comes up with a very good color, grows right up quick; and, no matter how dry the season may be, there will not be a leaf of that corn that will roll. That green mass lying at the bottom supplies moisture and keeps the corn green. Then in the fall (I always plough up two years in succession) I sow a bushel of rye to the acre, and put on the manure again. By the 20th of May the rye will be headed out, and I will have all that I can turn under with the plough. By doing that I get two heavy crops, and leave my land in a great deal better shape than it was before for grass. I find that is the most successful way of raising corn. I have been experimenting for five years now with a single acre. All the manure that has been put upon that acre has been six or eight loads of sea-drift. It is quite light land, and with that six or eight loads of sea drift and the rye that I plough under I keep it going year after year; and, if I should state the cost of the corn I have obtained, I don't suppose there are many here who would believe it. I gather the corn when it is just glazed over, and cut the fodder up and put it into the silo. Professor Goessmann tells us that it is worth four dollars a ton put into the silo. I kept an account of the cost of the corn grown on that acre last year, and it figures up thirty-two dollars and ten cents, including ploughing, cultivating, seed, taxes, interest, and everything of the kind. I have plenty of sea-drift, and there is no expense connected with that except that of hauling it. I had eight tons of green fodder, which is worth thirty-two dollars, according to the professor's estimate of the value. I had forty-five bushels of corn, that cost me just ten cents.

QUESTION. I would like to ask Dr. Fisher if he thinks it is advisable to keep apples out of doors in some cold place?

Dr. FISHER. No, sir. The trouble is, that the temperature is not uniform; it is cold nights and warm day-times. That is what we want to avoid. It is better to put them in the cellar, although it may be warmer than the average temperature out of doors, because of the uniformity. I have no difficulty in keeping Hubbardstons until the middle of February, Greenings until the last of March, and Baldwins until the middle of May.

Secretary SESSIONS. What is the advantage of your cold storage house?

Dr. FISHER. It is of no advantage, except that it is very uniform in temperature. There is no ice in it for refrigeration. I cool it down by opening it when it is colder outside than in; I shut it up as soon as the temperature outside becomes warm. When we have cold nights in the autumn I have no difficulty in cooling the apples down, but if warm days come on I find it difficult sometimes to cool them down.

QUESTION. A good many people head their barrels up, thinking the apples keep better in that way. What is your idea about that?

Dr. Fisher. They keep better so, but I never want to cover them up and send them to market a month afterwards. I want my apples to be sorted the day before they go to market, whatever time it may be. I can see them and handle them better if they are in boxes, open to inspection.

Question. Would you say that the same rules would apply to the keeping of turnips and other garden roots that apply to apples?

Dr. Fisher. I think the same rules would apply, except that they should be covered with something. But I would harvest them as late as possible, because the difficulty there is that the turnips will sprout if you put them in a warm cellar, and you therefore want to leave them out just as late as possible, and then put them in the coolest place you can find. If you can cover them with leaves or anything of the sort so as to keep the temperature uniform, they will keep as long as possible.

Secretary Sessions. I have one more question, "Which is the best early potato?" I would like to have Mr. Pierce of West Millbury answer it, if he will.

Mr. Pierce. That is rather more of a question than I feel qualified to answer. In my experience this year the Pearl of Savoy has been the best. They rotted considerably, but after the rotten ones were taken out there was a pretty good crop left. Next to that I would place the Beauty of Hebron.

Mr. Howe of Dudley. My experience in raising potatoes has been very little. The question of the use of salt was discussed this afternoon. I will say that I experimented with salt in raising potatoes this year, and it was a total failure. The salt was applied with chemical fertilizers, and not one-half of my seed came up. That satisfied me as to the expediency of using salt.

Mr. Peterson. Has any one had any experience with regard to the time of planting potatoes to prevent the rot?

Mr. Goddard of New Ipswich. I was very successful this year with my potato crop. I have always sprouted my early potatoes before planting them in the spring. I plant them just as early as the soil is fit to work, consequently I have never been much troubled with the rot. This year my early potatoes were ripe before the rust touched them. I have a number of varieties that did not rot at all. Many of them were dug last October, and they were just as nice potatoes as ever grew. I use a very little salt, and do not experience any difficulty. I always have the fertilizer well mixed with the soil before I drop the seed. I do not know that the salt was any benefit, but it certainly did not do any damage.

Mr. George B. Andrews. With regard to the question, "What is the best potato?" I would say that I think the New Queen is certainly a week earlier than the Beauty of Hebron, and is fully as good a potato. I have grown it for two years on sod that was never ploughed before, with chemical fertilizers, following the Rural New Yorker's French system. We have had two bad potato seasons, but I have not had a rotten potato on the farm. I have used no barnyard manure.

Mr. Goddard of Barre. Two years ago I had an experience that was a little new. It seemed to me it was different from what I had ever heard of then, and I have not heard of anything of the kind since. My potatoes rotted very badly, and I was advised that the sooner I dug them the better it would be. So I had them dug, and every potato that was not sound was left in the field. Those that were carried in were placed on the floor and allowed to remain long enough to be thoroughly dried. By the way, the ground was pretty wet when they were dug, and a good deal of dirt adhered to them, and of course it was not possible to tell absolutely whether they were sound or not; but, as I say, they were allowed to lie on the floor until they were thoroughly dried. Then they were carefully looked over, and a good many were found to be decaying. I intended to put into the cellar only such as were perfectly sound. Before spring I was obliged to pick over those potatoes three or four times, and every time found a good many decayed potatoes. Now, what I was coming to was this. Those potatoes were dug about the middle of September. Near the last of October I discovered that in one corner of the field there were perhaps twenty or twenty-five hills that had been overlooked. I dug them up, and I did not find a potato that had any signs of rot about it. I suppose that those that had rotted had completely decomposed. I did not find one rotten potato, but I did find just about as many sound ones as I had found when I dug the others. I put these in the cellar by themselves, and looked at them frequently. There was only a small quantity of them, perhaps half a bushel; but I found, although they remained there until spring, but one potato that was decayed, and that had a little dry rot on one end. Now, the point is this. I had always been instructed that as soon as potatoes began to rot the sooner they were dug the better. That experience upset that theory in my mind.

Mr. Bowker. I am very glad to get the experience of my friend from Barre, because it confirms the experience that I have had on my farm this year, which is located only a mile from Mr. Goddard's. I was persuaded by my foreman to leave one-half of the potatoes until late in the fall. He said that he had heard that if they were dug late they would not rot. I insisted that they should be dug early; but I finally said to him, "I will compromise with you. We will dig one-half the field early, and the other half we will let rest until late in the fall." Now, the potatoes that were dug early have nearly all rotted, are in a fearful condition, while the potatoes which were dug late are keeping fairly well in the cellar. But I have this to say, that the quality of the potatoes which were dug late is not as good as the quality of those that were dug early; that is to say, there is a flavor about them which I do not like; but they are keeping much better in the cellar than those which were dug early. Now, perhaps some of you saw the very interesting bulletin that was put out by our Hatch Experiment Station in October, in which they described this rot as a fungus growth, which attacked first the leaves and then traveled down the stalk of the plant into the tuber. They recommended that the potatoes that were attacked in that way should be dug, and the tops cut off and burned, so that this germ of rot, or this fungus, should be destroyed. I did not get that bulletin until all of the vines on my field were dead from this fungus growth, or I should have tried the experiment; but I think it would be well for our experiment stations to take up this matter and see if this fungus does travel down the stalk and into the tuber, and, if it does, if cutting off the stalk and burning it will prevent its getting into the tuber.

Dr. THOMAS PALMER. I do not happen to be a farmer working with my hands on my own acres, but, fortunately or unfortunately, I have a little farm in the outskirts of the town here. I made a little experiment in regard to the time of planting potatoes last year and the present year, that I would like to state. I planted two kinds very early,—the Early Rose and the Beauty of Hebron. I planted half an acre of each. I planted the first as soon as the frost was out of the ground. They were dug early, were free from rot, and are now keeping very finely, while those planted late last year would not pay for digging, and this year a good many of them have rotted. That is my experience.

Adjourned to 7.30.

EVENING SESSION.

The meeting was called to order at 7.30, Mr. Cruickshanks in the chair.

The CHAIRMAN. The committee of arrangements have added something to the programme for this evening, and I have the pleasure of introducing to you the Masonic Male Quartette, who will sing us a song.

The quartette, consisting of Messrs. C. E. Keyes, W. M. Barber, W. E. Macurda and L. M. Bartlett, sang a medley, which was loudly applauded, and in response to the encore they sang the favorite army song, "We are tenting to-night on the old camp ground," which was also heartily applauded.

The CHAIRMAN. The lecture upon the programme for this evening has for its title "Impressions received from Rambles in the West," by Prof. Levi Stockbridge of Amherst, whom I have the pleasure of introducing to you.

IMPRESSIONS RECEIVED FROM RAMBLES IN THE WEST.

BY PROF. LEVI STOCKBRIDGE OF AMHERST.

What, and where the West is located, is a matter of great uncertainty to-day. In the public mind, it has been constantly changing during the last forty years, and very rapidly during the last twenty. In my boyhood days, the West, — the far-away and almost unknown West, was in the Genesee and Black River valleys of New York. And then, passing over the region in the south-west part of that State, it was located along the valleys of the Ohio River and its northern tributaries, and the shores of Lake Erie. At that time the "Great North-west" was the territory of Michigan, respecting which as fabulous stories were told of the opportunities for getting rich quickly and by head-work alone, as have since been rehearsed of more distant regions. Soon the West was described to us as the boundless prairie-land of Indiana, Illinois and Wisconsin, with a soil so fertile that the only implements of tillage needed to secure the most marvelous crops, were a plough to turn the sod, and an axe to cut a hole in it, to insert the seed corn; and all centering at a mud-sunken shanty town at the south end of Lake Michigan, called Chicago. Then the Rock River country was the West, and its location gradually receded until it reached and crossed the Mississippi, and spread out in eastern Iowa. Here it lingered within reach of navigable waters for several years, for it was found that when the land carriage of farm crops was so extended, and the roads so bad, that it took two days' time and a pair of horses to convey enough of the crop to a place of sale to procure a pound of tea and a year's supply of family salt, the West had lost its immense attractions. Then Texas, with its measureless area and uncertain and disputed boundaries, was annexed to our south-western limits; and soon after, by force or fraud, — or both, New Mexico and California were gathered in, and our West halted by the waters of the Pacific Ocean. The precious metals were soon discovered in the rocks and sands of the latter State, followed by a gold fever, rising higher and higher, until it reached the point of a frenzied craze, and men lost their heads. At this juncture our settled Western limits did not advance by pressure of population or effort to secure homes; but, ignoring all ordinary motives, one wild, mad rush was made, without regard to distance, dangers or difficulties, for the place where it was said the shining ore could be gathered in handfuls. To reach the diggings, some risked a sea voyage of eleven thousand miles; others dared disease and death in the fetid swamps of the Isthmus; and many others took their lives in their hands, defying all the horrors of the little-known continental desert, the barriers of untrod snow-capped mountains and wild canons, the trackless alkaline plains, the animosity of lurking savages, and laid their way directly westward from the waters of the great river to those of the Pacific Ocean. Obstacles before unheard of or encountered hedged up their way. Many perished of weariness, of cold and starvation, and others fell by savage hands. Some, after indescribable sufferings, worn and exhausted, reached the goal sought, to find all ability to labor gone, and that the adage was true,—that all is not gold which glistens. They all suffered; a few received a recompense, most did not; but they marked out trails and passes westward, of immense value in the subsequent development of our domain. By their hardihood and pluck a great State was established in the region of the setting sun; but it was not the West,—it was only California.

Then came that to the North, sudden convulsion, to the South, the long and deliberately planned War of the Rebellion, for the dismemberment of the nation, and the extension and perpetuation of slavery. For a time the Union of the fathers appeared to be rent in twain from East to West, and there were mutterings in the air, that the Western and North-western States had so little direct connection with the parent States bordering on the Atlantic, that they would set up for themselves; that California, disconnected from all the others by two thousand miles of roadless deserts and impassable mountains, swarming with implacable foes, was beyond the reach of the forces of freedom, and would fall into the hands of those of slavery. The masses trembled in fear of the impending calamity, but soon rallied under the leadership of far-seeing, sagacious and courageous men. These, while marshaling forces for the field and providing materials of war, devised plans and instituted measures in the way of quick and easy communication to connect these scattered peoples, and to make their varied interests one, in the protection of, and benefits to be received from, the central government. At that time the railroad systems of the Eastern States were developed westward to and beyond the Mississippi. Our engineers had become expert and fertile in resources for overcoming, so far as then encountered, the obstacles presented by nature to railroad construction; and capital had been encouraged by success to make great expenditures for grand achievements. Impelled by these three forces, — the necessity, the skill and the courage, — the great continental railway system developed. The arid plains, the broad rivers with treacherous quicksands and shifting channels, the towering mountains with their perpendicularly walled gorges and canons, were passed, and a continuous track extended from the Atlantic to the Pacific, binding the Union together with a cable of steel. Other similar efforts and successes followed, which with their laterals have given easy access to more territory than can be fully and wisely utilized during a century to come, and made *our* West to be almost any and every spot between the "great father of waters" and the Pacific, and between Canada and the republic of Mexico. In the manifold obstacles to be encountered and overcome, the countless expense to be incurred, the grandeur and magnitude of the whole conception, the rapidity of its execution, — the world's history furnishes no parallel; and, for one, I am proud of the fact, that the sagacity, the indomitable, unyielding pluck, needed to complete the first line, was furnished by a son and citizen of Massachusetts.

But there is one phase of this matter which should be here noted, because of its influence on the West and its people. Notwithstanding the fact that the conception and plan of a Pacific railroad was by private individuals, acting in a private capacity, it was of national importance; essential to the government for the proper administration of the affairs of its vast area, and the expense of construction would be national in magnitude. In its own interest it should aid this most important of public enterprises. But it was burdened with the responsibility and cost of carrying on a gigantic war, and had no ready money; it could guarantee bonds, and was the owner of millions of acres of land along the proposed lines of construction. The land had then no money value, but certainly would have by the development of the enterprise. The scheme of "land grants" to aid railroad construction through our public domain was therefore inaugurated, and eventually extended, for purposes honest and dishonest, to all points where a road could be constructed, and whether it was, or ever would be, needed. The first road built received twenty-five million acres of land, and other roads a much larger grant in proportion to their importance. This land was in alternate sections, with surveyed government land on each side of, and contiguous to, the railroad track, which made it more valuable than government land farther back. In most instances the avails of its sale were sorely needed to pay construction debts, and the most extraordinary efforts were made for this purpose. The railroad corporations were actually transformed into great land trading and speculating companies. The East, both country and city, was flooded with flaming hand-bills, circulars and advertising cars, decked out with Western products, setting forth the quality and desirableness of their lands in the most preposterous terms. Their desert lands were represented as the best stock-breeding sections of the world, and the government lands of the same kind were free to all comers. A few dollars invested in a band of calves would increase so rapidly that in a very few years they would be countless, and a mine of wealth to their owner. The corn and wheat lands of their prairies and river bottoms were more fertile than the Garden of Eden; would yield eighty bushels per acre of the former and forty of the latter, and were absolutely exhaustless. Their mountains were rich with mines of gold and silver, and the sands of their mountain streams yellow with the golden grains. From the Rio Grande to Manitoba the climate was delightful; the dry, pure air of their high plateaus made them a perfect sanitarium; and, the nearer you went to the polar circle, the more agreeable it became. Copious streams flowed from all the mountain gorges, which could be so utilized for irrigation as to make the husbandman independent of the fickleness of the weather. They expatiated upon the generosity of the government; there was a homestead and a tree-planting law; and they rang all possible changes on "free homes in the West," "land for the landless," "Uncle Sam is rich enough to give us all a farm." It was not only in the Eastern States that these representations were made, but they had their agents in every country and city of Europe. Free transportation tickets were offered to land buyers and settlers; and soon the boom was on, and on hard. There was a rush westward, not only of the landless and those seeking homes, but of the titled nabobs of Europe, ready to take up whole counties, and of speculators and sharpers from everywhere; and the last were first in the field. Semi-officials of the railroads, and their friends who were in the railroad ring, took the lead. They knew, or could determine, where the railroad centres were to be, and secured all adjacent lands within the five-mile limit. By the time the first construction trains reached those points, a town was begun. Stakes tipped with red flannel are set in squares in the grass, indicating the line of proposed streets. Abutting lots are marked on these, and at once tents or brush booths are going up, and these signs adorn their fronts: "Building lots for sale;" "Land-Office;" "Real Estate Agency;" "Money to loan;" "Hobbie & Co., Brokers, money exchanged;" "Saloon, all kinds of the best of liquors;" "Guns, rifles and ammunition;" and, looking in at the open door of one or a half-dozen of them, you would see a couple of barrels covered with rough boards, and on these a dice-box, a pack of cards, a faro bank, and a black bottle.

Visit this locality a month or six months afterwards, and all is still, and the ground is littered with all kinds of trash, but empty bottles and old tin cans do most abound. It was found that a mistake was made; the projectors did not understand "the tip," or were purposely deceived; and therefore the "town" has moved on. Or else, at your second visit, you will find frame houses on the streets, decorated with the same signs; stone and brick foundations going in for banks, churches, school-houses and quite likely a theatre. Money is plenty, everybody (but the lambs) is getting rich; but yet, not a sod has been turned on the adjacent land, and the whole country is in its native wildness. Between these attractive railroad points and fancy "town sites" the scene changes; but the bottom motive power and the controlling actors are the same. The railroad in the form of friends is abroad in the land. All the *desirable* railroad lands are taken at a nominal price (to be resold of course for a consideration), and all the desirable government sections between have been secured "in ways that are very peculiar," under the homestead and tree-planting acts; and they can always find as many names to be used as there are desirable sections to be covered in, but which in due time turn back to the projectors of the scheme, who become the owners of domains of from ten to fifty thousand acres, but all for sale at a speculator's profit. These parties are not here to stay, except with an "if;" and, with an "if," they unload and "light out."

But now comes the great army of honest, guileless settlers, hundreds of thousands of them seeking homes. Many of them are from fairly comfortable homes in the Middle States; other many are from New England, with New England loves, and New England a part of their very being. They have believed the story of "land for the landless, free homes for the emigrant;" they come to make homes of broad acres and to leave them to their children, surrounded by all the blessings of Eastern life, but which Western conditions cannot produce, and money cannot buy. Along the great trunk lines they crowd, accompanied by wife and children, and bearing a few household goods and gods. Mingled with foreigners babbling in an unknown tongue, and jostled by land sharks and sharpers, they swarm around the land-offices, to obtain the first title to that magnificent farm of which they have heard so much, and which in their mind's eye they have so often seen. But they find that somebody has been there before them; land is not so free or so near at hand as they supposed. Their Uncle Samuel is not at home to walk out along the railroad, and stake off the alternate sections for their occupancy. But they are told that there is such land as they want at a distance, — "no better land in the world than that up around Devil's Lake or out in the north part of Burleigh County." "The best stock ranges are out in the Bad Lands of Montana." "Gold is abundant in Nevada, and the claims are not half taken." The great crowd looks downcast; but it scatters from the offices of the loaners and exchangers of money, from the land-offices and real estate dealers, from the rambling toad-stool villages, and disappears in the vast expanse of prairie, plain, mountain range and sequestered gulch, to find, if possible by searching, the home which they supposed was ready to receive them.

This country, thus opened, thus advertised, and thus settled, is *the West*, over which we are to ramble, and we had better be off before another like invasion arrives. Now we are at Casselton, in the great valley of the Red River of the North. It is one boundless expanse of dark, friable soil; and here and there to the farthest horizon we see the smoke of steam threshers on the wheat fields, and the teams moving wheat in the straw to the machines, grain to the elevators and water for the boiler. The scene is new, it is enchanting and expanding. Roving free, we find we are on the great wheat farm of Mr. D. and soon at the central office. To the Yankee's questions come these answers: "Seventy thousand acres in the ranch, twenty-nine thousand acres in wheat this year, the rest unbroken sod." "The average yield is forty bushels per acre; the machines thresh on the average fifteen hundred bushels a day each; it costs from a cent to a cent and a half a bushel to thresh it." "The expense of growing it, from the plough to the elevator, is about twelve or fifteen cents a bushel; this land is all soil, and of the best down as far as you can dig." "It has been waiting here for the plough, and growing richer and richer for thousands of years, and it will produce wheat for a thousand to come without exhaustion." "The air is so pure and dry we don't feel any cold, and the winters are agreeable."

Thanking the gentleman for his politeness, and still rambling free, in due time we find ourselves far away on the wheat fields, and among the men, the teams and threshing machines. The latter are all steamers, and burning straw, which is a Western phase of economy, and a novelty to New England eyes. The rush of steam, the roar of the thresher, the flying dust and smoke obscure everything; and for a short time you are confused, but soon discover that there is order and a controlling head behind the dusty screen. And you run up against a live Yankee from Connecticut, the boss of four sections (about twenty-six hundred acres) of this land, its teams, implements and crops. He is glad to greet anything in the way of a fresh Yankee or tender-foot, ready to talk, and knows his business. With some banter and giving news from the East, questions for information are put, but for brevity's sake only the answers are given: "Have been out here four years, summer and winter, but came as an emigrant, not after this job." "In some respects I like it better than old Connecticut; get fifty dollars a month the year round, but all don't get that." "Don't have anything to do in the winter but take care of the stock (the teams); there is no field work that men or teams can do." "Well, now, the crops do fall off some; don't average more than fifteen bushels to the acre; but we shall take up some new land next year, and fallow some of the stubble, taking a crop once in two or three years." "There is not so much capital in this establishment as you might think; preferred stock of the railroad was bought at seven dollars a share, and swapped to the company, at a hundred dollars a share, for this land at a twisted two dollars an acre." "Don't know how much money they make or lose." "Know that bankruptcy is common around here, but they are all right; these great Western arable farms will be cut up and sold out when the times are right, and prices high enough." "You expect to get a slice then, do you not?" "I shouldn't wonder." "Those fellows up on Goose Creek brag well; they may get twenty-two bushels an acre this year, but last year they didn't get ten; I guess it will average about like ours." "That ditch is for a pipe to bring water from the wind mill at the creek to the elevator; it is two miles long." "Ten feet seems deep to you for a water pipe, but in August we dug out junks of frost down nine feet." "Summers are short, but we can begin early; are sowing when two or three inches are thawed out on the surface; what frost is below that can thaw when it gets ready, — the wheat will grow." "I don't find any fault with the climate; it's good if you like it; and when you fellows down East are shivering around in your winter fogs, you can come out here and get warm, however low the thermometer is." "Yes; shall finish threshing to-morrow, and the next day the men will go to burning the straw; and the teams, four mules and driver and a two-plough gang, will commence ploughing at that line, and go straight away yonder four miles across the four sections and back; and they will alternate, traveling sixteen miles one day and twenty-four the next, and will keep it up until the ground freezes." We thanked the man for his time and information, and turned away with the impression that we had seen only the best side, the outside, the glossed side of the affair. As we did so, he called after us, "Say, you, if you ever go round old Connecticut way, salute it for me; for I call it home, and the old folks are there yet."

Now we find ourselves well up the Little Missouri River, in the Bad Lands of Western Dakota. Winding and twisting our way along for many a weary mile among the clay buttes, the scene constantly wilder and more forbidding, a sudden turn of the trail brings us face to face with a typical cow-boy. He is mounted on a thin-necked, sharp-eared, bright-eyed, restless broncho. Hanging in a case at the horn of his saddle is a Winchester rifle; on his right hip a heavy revolver, and a large hunting knife in its case on the left; around his person two leather belts filled with cartridges, one for the rifle, one for the revolver; moccasins on his feet; leather leggins; a brown corduroy coat and a brown felt hat large enough for an umbrella; his face is bearded and browned; he looks the bandit (and here is where such roam uncaught), and you almost expect to hear the order, "Stand and hold up." To the inquiry, "Does this trail lead to Mr. C.'s ranch?" came the answer, in a bright, cheery voice, as his countenance lighted up with a smile, "No; here you are, and yonder is the shack." "Are you Mr. C.?" "I am, and am glad to see you." "Well, you look like a galloping arsenal. What do you load yourself down with all that artillery for?" "It is sometimes mighty handy to have it around; a man ought always to have it on here, and its presence may prevent the necessity for its use." In a few moments we are at the shack, which, we notice as we approach, is about fifteen feet square, seven feet high, made of poles about five inches through, sides and top, interspaces filled with clay, and daubed over top and sides with the same material. All around the eaves antlered heads were fastened, on which were hanging the carcass of a deer, saddles, harness, yokes, lariats, etc.; and through the open door could be seen an earth floor, bunks, blankets, skins, a sheet-iron stove, and a few cooking utensils. We alight, and stand at the home and head quarters cattle ranch of a college graduate born and reared in Philadelphia, and now three years a cow-boy. He was evidently pleased with the visit, as evinced by the hearty exclamation, "Gentlemen, I am glad to see you here; it does a fellow good to see somebody from God's country once more. How is all the world — the men, but especially the girls — down East?" He seems glad to see a new face, and to talk to somebody besides the two stolid helpers he has in his employ; and so we will let him talk, and see what we can learn of him, his business, the country in which he lives and its people.

"After college graduation, and casting about awhile for something to do, I concluded the professions were so crowded I should have hard work to squeeze in anywhere; in fact, people were getting pretty thick in Philadelphia. There was a good deal said about the chances to make money in the stock business out here; and, having a little capital with which to start, I thought I would come and grow up with the country, as Greeley advised. Could not have gone much farther if I had tried. Could not have found a place where I could have a cleaner sweep and swing; have pure, free air, free water, free land; free of all law and law officers but those shooting irons; free of all the dissipations of civilization; free of all human kind, except an occasional fellow to whom we point our rifles, and the section gang ten miles away down at the railroad. Business don't amount to much yet; think I have about eight hundred head of stock, old and young, and shall begin to sell next year. Cannot show them to you; don't know where they all are, but shall have them all back on the range within a month, but may have to go a hundred miles after some of them down to the reservation. This is the worst-looking country, and the hardest to find anything in, that man or pony ever trod; but there is feed enough, and it is the best to *winter* stock in there is in the whole realm. They huddle into these gulches and ravines, and do not drift before the blizzards; and when the storms are over they nose their way out of the snow, rustle around and fill themselves with willow and cotton-wood browse. I don't lose more than about fifteen per cent of them in a year, from cold, snow, wolves, bears, cats, and accidents, all combined; but away south on the plains, drifting before storms, freezing and starvation are liable to clean out from fifty to ninety per cent; and if it doesn't take cow-boys, too, they are lucky. We don't do much in the winter, and would not do anything but eat, sleep, and keep a fire, if the cattle did not rove; but they do sometimes, when we have to rustle around and keep them on the range, regardless of snow, wind or weather. Game? Yes, game is plenty, and we get it without much trouble when looking after cattle. We get letters occasionally, and papers; and I know that a month ago Philadelphia still stood on the banks of the Delaware; but can't say that I know much of the prevailing fashions there, and care less, for I know we are in the full swim of fashion out here. The mail comes every day down at the station; but that is ten miles away, and in winter that is farther than a hundred miles anywhere in the East. In the summer we get down there once a week sometimes; then again we are away on the range, and don't bring around once a month. We don't have the advantage of lectures, conventions, balls and circuses; but we don't care much about that, for our business is about equal to a perpetual circus. Oh, we sha'n't starve, with eight hundred head of stock around us, and deer's heads sticking out of every other bunch of scrub. We get some canned goods, coffee, tea, salt, etc.; should like fresh vegetables and apples. We have deer-skins in abundance, and that supplies most of our want of dry goods. Our establishment is rather primitive, in fact, not quite up in style to that of Abraham the great ranchman of the East; but you know 'man wants but little here below, nor wants that little long.' But you give me a call in July next year, and you will find me in style. I am going to have my mother and sister here then. Before they come I shall tear this shack down and build a new one, — a nice one with two rooms; am bound it shall have every modern convenience, if it costs me fifty dollars. I am bound that they shall have a good time here, and see the West as it is, and its people as they are. We will have all the people of the county here, and we will have a *social* time."

"Mr. C., how large is this county?" "I don't know exactly, but I think about as large as the State of Vermont." "How many inhabitants in it?" "I don't know of any *fixed inhabitants* but the section gang at the railroad, but there are some scattered around; a squad of cavalry comes along occasionally, and there may be one then." "I doubt not, Mr. C., your mother will be delighted to meet your friends and neighbors, and to see the country in which her son has pitched his tent." "I don't know about that, but I know she will be delighted to see me, and I shall to see her; and the beaus won't be so thick but that I can have that sister of mine to myself for a time; and for the rest I don't care."

Mr. C. entertained us on the fat of the land, and apparently regretted our departure; and we left with the impression that the next time we rambled that way, not a track of the scholar and ranchman would be found in the Bad Lands, but we should learn that he, and what capital he had saved from that which he brought from the East, had gone back there, and the country left to grow up without him.

But now the scene changes; we are running west on the North-western Railroad in the south-western part of Minnesota, and near the Dakota and the Iowa line. We are in a region famous for its wide-spreading prairies and good quality of soil. The horizon is far, far away in all directions, and the view unobstructed. Along the track side are occasional reaches of turned sod or stubble. From the moving train it is difficult to clearly distinguish human habitations away from the little villages, but at intervals smoke is seen to rise, and there are stacks of grain or hay. We run to the end of the road, and find ourselves in a little village three years old. A conspicuous object is a grain elevator; there are several shanty stores, a half hotel, half boarding-house, a land-office, real estate agency, a broker's office, and two or three saloons. A school-house was under way, "as an advertisement;" but they were "not so advanced as to think of churches." There was a dealer in all kinds of agricultural implements, machinery and vehicles, which were scattered around promiscuously in the prairie grass over an acre of land. We are hardly domiciled for the night before most of the villagers know we are not there to sell patents, lend money or buy land, but rather to see the land which is sold, the men who have bought it, how they like it and its surroundings, what they propose to do with it, and how they live. This information given, we have ceased to be an object of special attraction. We inquire for other settlements or villages in the region, and are told there are none; for roads out of this metropolis into the out country, and receive for reply, "Roads! it is all road; go where you please, — there is nothing to hinder."

As the next morning's sun lighted up the scene, that remark was fully appreciated. Grass — brown, dry grass — under foot in every direction, and not an object to obstruct the view or attract attention. But how far does this expanse extend, who owns this land, and what is beyond it, are curiosity-provoking thoughts; and we start out due southwest by compass for a long tramp of discovery. As we advance, the horizon recedes. The prairie, which appeared so absolutely level, is found to gently undulate in long, smooth swells. These swells come plainer and plainer to view as we move on, and behind fall away to the horizon. For miles the scene is the same; and it would be very monotonous but for the occasional whir of a prairie chick out of the grass, whose flight is hastened rather than retarded by the gun we bear.

After miles of tramping, the field-glass brings to view a something at the horizon which is unusual and artificial rather than natural, and the course is laid in that direction;

as we advance, it comes plainly into view, and after a walk of two miles we find we are approaching the dwelling of a homesteader. As we draw near, we note it and its surroundings. It stands on the summit of a prairie roll; is a board shanty about twenty feet square, with a stove-pipe chimney. There is a small glass window on the side of approach, where it seems there should also be a door; but, as there is none, we conclude the front door is on the back side. We notice there is a pole barn, covered, roof and sides, heavily with straw, which is black by a year's exposure; off to the left is a stubble field, and beyond, a dozen head of cows and young cattle feeding. Near the barn are two stacks of wheat and four or five of hay, and scattered around the premises sundry farm implements and a good two-horse wagon, but no other vehicle.

But we are now too near to be longer unnoticed, and our approach is announced by the sharp bark of a fine collie dog. By the time we are within speaking distance, a man is seen coming from the barn, a boy of about seven years of age and a girl of five from the direction of the hay stacks, and a woman appears at the door. A glance showed that all were comfortably and neatly dressed, had an intelligent but a sort of scared, quizzical look, as much as to say, "Who are you? where did you come from? what brings you here? — but we are glad to see even you." Salutations were exchanged without much embarrassment on either side. They were told that we had fallen in with their place while roving out from C., but that we were from the East. "Are you?" said the woman, with animation; "We are from the East." "From what State, madam?" "From Ohio." "Then we were neighbors; Massachusetts is my home." That was enough; all embarrassment was removed, and conversation flowed freely respecting the East and the West. With occasional leading questions to draw it out, the homesteader's story was practically as follows, told sometimes by the husband and sometimes by the wife: —

"We had a good little farm in Ohio in a thickly settled neighborhood, with school, church, store and post-office close by. But there was a mortgage on the farm which we could pay off only slowly, everything we had to sell was so low. A good opportunity occurred to sell out, and we concluded to do it, get out of debt, and take what we had left, come West, get a larger farm for nothing, fit it up and begin anew. Good recommendations led us to this locality, of which, however, we had no actual knowledge until we reached here. We did not find it just as we expected. We supposed we could get a location near the railroad and convenient to town privileges, but nothing could be homesteaded there. Then there was no wood for fuel or timber or fences. We wanted to both keep stock and make crops, and a good barn shelter for them and a house for ourselves. The timber to do this must be brought from the far north through Chicago or St. Paul, and it would all cost more than we could afford. We could not go farther, and disliked to go back, and finally concluded to make the best of the situation as a trial.

"We got here in July, year before last, and you can see what we have done. We brought a few household goods with us, and soon after getting here we bought a pair of horses, a wagon, and all the rig, some tools and two cows. That season we built the house, a part of the barn, set over a piece of sod for spring wheat, and cut and stacked a lot of hay, some for the stock and more to burn. I have now grown two fair crops of wheat of two hundred bushels each, a little corn, and all the prime roots and vegetables we wanted. The cattle have increased, and we are better off than when we lived on this spot in a two-horse wagon. We haven't got everything we want yet, — water, for one thing. You see that pile of dirt out there? that is where we are digging a well. We are down now forty feet, but five or six feet more will bring it. To this time we have brought all we have had a mile and a half, in barrels, from the sink down yonder. This soil is good, and no mistake, — better, I think, than it was in Ohio.

"The climate, — well, you should live in it a year or two to appreciate it. If it is good, it is good; but when it gets on a tantrum you had better stand from under. A blizzard struck us last year in May, and we had a terrible one the 18th of the following October. Describe a blizzard? No; I don't know any words which meet the case. The wind sweeps across this open country, roaring, howling and shrieking in a way nobody can describe; the little ice needles are driven by the wind into and through everything. Then the cold is awful, and nothing but hay to burn; and quite likely you will be caught without enough in the house to last through the storm. If you want to appreciate a blizzard, come, see and feel it, but be caught in it at your peril. If one had come in October, the first fall we were here, none of us would have been here to tell the story.

"Prairie fires? You would think so; and the grass is about dry enough to burn now. When the fire gets going, and a high wind gets behind it, it seems as if the whole world and all in it were going to burn up. The smoke and heat go ahead of the fire, and it is dark as night, and you are almost suffocated. Hardly know which to choose — a prairie fire or a blizzard. On some accounts we have the most dread of the fire, and keep the grass mown and fed back a hundred rods from the place, and then plough a fire-guard inside and outside of that line; so that we have escaped thus far. But fires have swept over whole counties here, and cleaned out everything, — villages and all.

"As yet, there is practically nothing that farmers can raise to sell in this region but wheat, and that might about as well be burned as sold. It is hard to find a man here who raises more than about two hundred bushels, and he cannot take or send that much to the Chicago market. Either way, the freights and commissions will take the whole crop.

"On the way out you probably noticed elevators once in twenty or thirty miles all along the railroad. The railroad ring own them all, whatever may be the name painted on their brown sides. Oh, yes; they are ready to buy wheat; 'but the crop is not a desirable one, and the market is glutted; but if you cannot hold it, draw it in, — we will give what the market will afford.' They have a sure thing, and can wait; the farmer generally cannot; so the crop goes to the elevator, and of course in the worst possible time. 'There never was such a glut;' it is hard, but the best they can do is forty-five cents a bushel. That won't do for the farmer at all; but it is thirty miles to the next elevator, which is two days' journey from home, and when he gets there he is in the power of the same ring; and so the wheat raiser surrenders, and the weighing commences. A bag or two is emptied, when the buyer discovers the wheat is not up to standard, is not well cleaned; he won't have it; the farmer may take it back, or throw off ten per cent for refanning. The farmer yields again from necessity, thinking it is but one load, and it is soon in the machinery; but 'Cash is short to-day, and we cannot pay now possibly, but will be ready and cash it when the whole crop is delivered.' The farmer goes home a wiser but not a happier man; but the buyer gets his whole crop, and nearly all others that are in the vicinity, in kindred ways. That is how and where we get our money.

"We are comfortable, as comfort goes out here; but yet we have, as you see, no roads; a month in the fall, six weeks in the spring, and after every great rain, we are mud-bound, however great our necessities. We could not get land nearer the village and depot; it is ten miles there, and somebody owns the land all the way, and is holding it for a rise. We have no schools, no society, no meetings, no doctor; yet people die out here."

During this conversation we were sitting on a wagon-seat placed on the ground; thinking it was taking a gloomy turn, we arose as if to go, but were cordially invited to walk into the house and take a cup of tea, to "strengthen us" for a ten-mile tramp to the village. The little boy ran to the hay stack from which he came on our arrival, and immediately returned bringing some loose hay and a handful of twists. We then discovered that he and his sister had been engaged in twisting and piling hay for use during winter blizzards. Entering the house, we noticed it had really but one room, with two small windows; there was a bed in one corner, from beneath which peeped a trundle-bed; there was a large sheet-iron stove, a small table, a chest; shelves around the walls, on which were pans of milk and an assortment of crockery and tin-ware; in a closet near the stove sundry cooking utensils, four chairs about the room, and all neat and tidy. In a wonderfully short time the burning hay made the steam whistle from the spout of the tea-kettle, and soon "a humming cup of tea" was presented us. That sipped, we thanked them for their hospitality, bade them good-by, and took our compass course north-east for town. As we turned away, the woman said, pleasantly, "If you meet anyone who wants to buy an improved claim, send them this way;" and I received the impression that she meant all she said, and a good deal more.

During the two following days we are riding in different directions over this much-boomed section of country, and find farmers long distances apart, in out-of-the-way places; some in side-hill "dug-outs," some in turf shanties with a single window and earth for a floor, and some establishments of the kind abandoned and claim given up. Occasionally we found a settler and his wife who appeared bright and cheerful; but most them, especially the wives, bore a sorrowful countenance, as if the light of their lives had gone out. We have not time to particularize and make comparisons here; and only stop to say we left the section with the impression that the family interviewed during our first day's ramble were country nabobs in that land; and, if they did not sell out, have probably finished their well, and have an abundance of water.

But now we are away across the continent to the south-west; have passed through the canons and gorges of the Rockies; have looked with awe at the snow-covered Spanish Peaks; have succeeded in the struggle up Pike's Peak trail to the summit; and have reached a dry, thirsty and barren, though boomed, land, and stop to take breath at Las Vegas, New Mexico. We cannot stop to describe its wonderful hot soda and sulphur springs, or their boasted curative properties; but hasten to tell of a *discovery* we thought we made here, but afterwards found to be as common all over the Western country as hay-seed. It was what might be called a professional emigrant. We saw a sturdy man with a pair of good mules grading around the railroad hotel (the Montezuma). He looked and talked like a Yankee; not quite that, but certainly he was not a foreigner. At noon, when roving on the outskirts of the village, we noticed the same man with the team put out, and feeding from the rear end of the wagon. Himself, a woman and three children were seated on the ground near by, eating their dinner from tin plates held in their laps, the food reservoir being an iron spider, and their drinking cup an old fruit can. There was a fire smouldering a few feet away, between three flat stones set edgewise. Near by on the ground was the canvas-covered top of the wagon, which for the time being was evidently serving the purpose of a tent, and in which were a few household goods, — boxes, bundles, and what looked like bedding. At a little distance, browsing in the sage brush, were two Indian ponies, for riding when the party was on the move. The man and his wife appeared to be about forty five years of age, the children — two boys and a girl — about twelve, ten and seven. Salutations were given and received; and, as there was no bashfulness on their part, a rattling conversation was soon on the flow. The story, told with little interruption or prompting, was as follows: —

"We are of Massachusetts origin, but were born and reared in central New York, and commenced married life there on an inherited farm about twenty years ago. The farm was a good one, we think now; but we caught the Western and the lumber fever, and sold out and went to northern Michigan and bought in the woods. Stayed there most three years, but didn't like it; didn't like logging, didn't like the woods, didn't like the stumps, couldn't stand the cold in winter nor the mosquitoes in summer, and so sold and went to Wisconsin. Did not buy there, but rented a place for one year; but found it to be Michigan over again, so concluded to try the prairie country; and went out to Nebraska and bought an improved claim with a good turf house and some tools on it, but no barn.

"The first year was a good one, so far as crops were concerned; but neighbors were few and far between, and they were Dutch or something of the kind, — we couldn't understand their lingo. We had to burn up most of our corn for want of wood, for there was none in that country. There was little market for what we had to sell, and what there was was so far away that it didn't pay to go for it.

"The second year was a bad one. There was a great drought. The crops and grass all dried up, and we sat up nights to watch, fearing the prairies would burn over in July. That winter we had blizzard after blizzard, and it seemed as if we should freeze solid and blow away; and I believe we should, if we had not been completely snowed under; as it was, we froze our ears lying in bed.

"The third year was good enough, but, with the cost of building a pole barn, we did not get ahead any, but rather fell behind.

"The fourth year promised splendidly. Corn, wheat and grass grew as we never saw them in York State. But one day, just as wheat was beginning to turn, we noticed a sort of cloud coming up from the south-east and coming directly towards us, growing darker as it came; and then it began to roar like Niagara at a distance, or near by, for that matter; the sunlight went out, and almost before we knew what the matter was the locusts came down upon us. They flew into our faces and caught in our hair, and filled the house before we could shut the door and window; they completely covered the ground and all the plants there were on it; and the gnawing, grating, whirring roar was awful. It did not take them long to eat every particle of a plant there was on the farm and all the surrounding country, and to scratch up their roots, and the last that came starved for want of fodder, making a smell about as bad as a slaughter house. There was nothing left for us, and we 'lit out' and went down to Kansas, where I got a job on the railroad. I made up my mind that locusts were too much for us, and the first man who wanted that farm and try his hand with them would have it, and he did; and we took a year to look around and find a place where a man could live and have a decent show.

"The next spring we went off south-west a hundred miles in the State, and bought out a fellow and went to work. Times were lively there, so far as settling up the country was concerned; but the emigrants were a mongrel crowd from every part of the world. They were late in coming in, and it rained all the time until the middle of June, and the land could not be worked. Half of them could not get cover, and when hot weather came on they took the shakes, and kept it up all summer. What crops they got in didn't do any too well, and were not grown when a stinging frost came in September and killed everything. That was a tough winter; it seemed as if those foreigners would starve, and we were not much better off. Some of them went off, and loads of provision were bought by somebody to feed those who stayed.

"After that the look ahead wasn't bright, there wasn't grain enough in the country for spring planting; so, as soon as we could travel, we put our claim into the hands of an agent to sell, and, rigging up a prairie schooner, headed for Colorado, thinking as hard luck followed all trials at farming, we would try mining for a change. It was a long journey and a rough one, but we struck Pike's Peak after a while, and went on up to Denver. There were people enough, and hurrah enough, and mining talk enough, there; but no mines. So we kept on west into a crack of the mountain so narrow and so deep that sunlight didn't reach the bottom, and it was crookeder than a meadow brook; but it led at last to a mining town that was hanging around promiscuously in the sides of the ledges, and called Blackhawk. It didn't take more than two days for me to find out that we were out of place. I could not find any leads, veins or color of gold on the surface, I wouldn't work in a dark hole a thousand feet deep down in the bowels of the mountain, and I couldn't make salt shoveling and washing gravel down in Clear Creek with a gang of Chinamen. But I had my team, and could get good wages hauling rocks to the smelter; so we concluded to stop awhile, and we did for eighteen months, but all the time trying to get information so that the next move should be a good one, and a final one. Our plans were finally laid, and we are so far on our way to carry them out, and have only stopped here for a few weeks to rest and refit. We have started for southern California, to go into fruit raising; for, from all we can learn, that is the coming thing. But of all the countries man or beast ever traveled over, this along here caps the whole; it is all in hummocks tipped up or tipped down, there is no rain, no water unless it smells of brimstone, nothing grows on it but sage brush; and this journey I reckon is like going through purgatory to paradise."

We did not dispute him, but bade the family good-by, impressed by the sad, weary, hopeless look stamped on the face of that wife and mother; and also that men of a certain mental mold are like plants, indigenous, and it is unnatural that they should take root and thrive as exotics.

But we will take the train and hie away across the deserts to California, and see what our chronic emigrant will see when he reaches the end of his long journey, and gets into the full swim of his "coming thing." We are now in the vicinity of Los Angeles, and it is the beautiful month of June, when the hills and valleys of New England are in all their glory of verdure and bloom, the air loaded with sweet perfume and vocal with the music of singing birds; but here the great range of view is brown and sere. The wild oats, the only native herbage on the hill-sides, are seeded and dead. Here and there are green spots of grove or vineyard, but they only serve to make the great sweep of country look more forbidding. The traveled roads are inches deep with a fine, almost impalpable dust, the color of yellow snuff, and about as pungent to eyes and nostrils. As teams or equestrians pass along, it rises and settles upon and in everything, leaving its dirty hue. Far away in the line of the road we are pursuing we notice a dense cloud rising, and we remark to the driver of our vehicle, "A rain is coming up yonder; we thought you did not have rain here at this season of the year." He gave us a quizzical look, as much as to say, "You *are* a green one;" and replied, "I reckon it will be a dry one, but wait and see." We did not have long to wait before we found the cloud was dust raised by a flock of two thousand sheep, who, as they moved along nipping here and there a tuft of dry herbage, raised so thick a cloud of dust that only the outer edge of the flock could be distinctly seen. Sheep, dog and shepherd were coughing and sneezing; all were of dark snuff color, all looked haggard and dejected, and the last demented, — at any rate, he was uncommunicative. We remarked to our driver, "This is a hard-looking country now, but I suppose you have rain in the winter, and the country looks fine." His reply was, "Yes, perhaps so; the country is fine enough, but it rains all the time, the roads become a perfect porridge, the bottom drops out, tourists don't come, you can't get around, business is dead, and we den up. Give me the dry season, dust and all."

As we passed along the road in another section, at many a spot men were cutting down orange groves, trees from six to ten inches in diameter. An inquiry of one of the bosses brought the information that the scale had got the better of them; that as they grew larger they needed more water, which could not be had; and they must go into some other business, he hardly knew what, on account of the water question.

We retired from the scene with the impression that the country had been boomed to death, and that, when our chronic emigrator reached it from New Mexico, he would be impressed in the same way, and find swarms of sympathizers, if their " grin and bear it " would let them talk.

But we are away, and pass on to the north, to a section famous for the rugged grandeur of its scenery, and find ourselves near the south fork of the American River in the Sierras, where gold mines in all forms and conditions of deposit and development are said to abound, and to have yielded untold millions. We find nothing inviting here but the wild sublimity of the mountains, and the reputation that they contain gold, which by searching may be found. A little exploration discloses the fact that simple placer mining, hydraulic mining and stamp mining are being practiced; and in due time we find ourselves at a mining camp, consisting of one small shanty, one man, and one dark hole down into the mountain rock, at the surface of which is a rough windlass, with a crank to be turned by hand. Our approach was discovered, and hailed by a hearty, " How are you? Are you lost, or only looking for something?" We replied, " Both." " Well," said the man, " come inside and tell all about the country you came from and its people, and how you came to be here." The invitation was accepted, and we stood in the mining home of two graduates of a Massachusetts college, whom we knew to be good geologists, mineralogists and chemists. News from the East was eagerly sought, and from friends near and far. The conversation gradually drifted to personal experiences among mines and mining camps during the three years then passed, and this is the story, told in few words: —

" C. is half owner of all there is here, but got discouraged, and about eight months ago went off to Nevada City and got a superintendent job there; but I have stuck to this mine off and on, thinking we could not be mistaken, and if indications were good for anything we should get something worth having if we could contrive to live until we got the shaft deep enough.

"When we first came out here we thought we knew about rocks and metals, but went into the employment of Sargent, down at Georgetown, to get a practical knowledge of mining as a business. After eight months there we took a month to visit mines in all directions to see the character of the rocks in which the metal was found, and the different methods of approach and reduction. We then started out independently on an extended prospecting tour. We found several places that miners would call a good prospect, but in our opinion the best show was here. Therefore we secured a patent, got suitable tools, and began work sinking a shaft. Near the surface we struck a quartz vein, and got some beautiful specimens of free gold, and thought our fortune was made; but it was so thin it yielded but little, and soon pinched out. The shaft is now seventy feet deep; at intervals as we went down we found a little color, but did not strike it rich, and more than once we were dead broke. It is pretty difficult in such a place to tell what the show may be a day or a week ahead.

"Soon after C. went away, just for a change, a friend of mine went with me over into Placer County, to a place that C. and I had spotted, and secured a right and went to work sinking a shaft in decomposing talcose slate rock, in which veins of soft, gold-bearing quartz frequently occur. We worked hard for several months, and, as the rock was not hard, we got down about forty feet, but did not find a trace of anything; and I got discouraged, and thought I had rather put work into our old mine. So one morning, just after I reached the bottom of the shaft, I said to A., 'What will you give me for all my right, title and interest in this hole?' His reply was, 'I had rather sell than buy; but I will run for luck, and give you fifty dollars; but you shall wait for your pay until I take it out of the mine.' 'It is yours,' said I, and did not strike another blow, but got up top of the ground and tramped back here. Then something happened, the like of which has happened before in this country. A. got into the hole which I left, took up my pick and went to work; and before night of that day he uncovered a pocket of soft, clayey material, about the size of a barrel, out of which he took twenty-five thousand dollars' worth of gold. The news was not long in getting over here, and it made me and this whole mountain so blue that it fairly smelt of sulphur. That find had one good effect on me, — I got my fifty dollars, and a little more as a present, otherwise I should not have received, as really I did not expect, a single cent. But A. was affected in a different way; he thought he saw himself a millionaire in the near future, and hired gangs of men, and put up costly machinery; but to this time he has not found a trace of color, and quite likely will not, and will exhaust his whole find. That is the way it goes here. A knowledge of rocks and minerals, and even practical experience, are all at fault in this business.

"Before C. and I began for ourselves, we visited all kinds of mines, saw all sorts of mining operations, ran against all classes of miners, from the old forty-niners down to the tender-footed; and we have found but two classes who in the long run have made more than a fair living, and they are: first, those who by accident have made a rich find, like A., and had sense enough to leave the business at once; and second, those who dug shafts or tunnels into the mountains, 'salted' them well, told stories of their fabulous richness, stocked them, increasing the number of shares as long as they could find fools to buy, and then disappeared with their pile; or still others, who owned fairly good paying mines, but stocked them at a thousand times their real value, sold the stock, and retired millionaires. The rank and file of the immense army of gold seekers have been roving helter-skelter through all the wild mountain gorges of the West and California. You will find their abandoned pits and tunnels where you would not have believed the foot of man had ever trod; and each tells of great and bright hopes blasted.

"I know this region well; it has the reputation of being the best mining section in the whole country; and, if you will pay the expenses of the trip, I will take you around, let you see for yourself and invest if you wish, for you will find the chances are plenty."

We accepted his very reasonable proposition, and tramped and climbed and rode for a week among mountains and mines; saw gold taken from the stamp mills in the form of quicksilver amalgam, saw it washed from the "putty" banks and caught on the sluice ripples, saw it cradled out of the creek sands and pounded out of crumbling quartz in an iron mortar; interviewed mine superintendents and day workmen, and were confirmed in the impression that our guide and friend knew what he had previously told us, and that practical mining in the mountains was quite unlike that which is done in the stock markets of New York and San Francisco. Those two young men are now in New England, and successful, in important and responsible positions.

But, you may ask, are there no contented, happy households, no towns and cities of solid growth; nothing that is bright and encouraging in a business line, in the West? Yes, we answer, many and much every way; but that side of the story has been told a thousand times in a thousand ways by all the known methods of creating public opinion. Our path has been behind the scenes, as it were, among the producing classes, who alone create the necessity for towns and cities, and who sustain them; whose voice the great public rarely hears, and whose struggles and deprivations are not known or appreciated. Land, as a gift on a wide prairie in the West, costs more, when the comforts and conveniences of Eastern homes are placed upon and around it, than the same does here. The rich may emigrate to such a locality; but the poor man or the one in moderate circumstances, with a family, never should. Within the last few months a great crowd of emigrants have been making a wild rush for Oklahoma, as if pursued by a devastating prairie fire, or a horde of blood-thirsty, screeching savages. That rush was not made because those people were in search of land for homes, and there was none to be had except in Oklahoma, for there were millions of unoccupied acres behind as good as those before. Neither has this vast emigration from the East to the West been caused by pressure of population on food supply. Throwing out the areas of water, we have 540,204,160 acres of land on the east side of the Mississippi River. Allowing that one-third of this is mountain range and unimprovable land, we have left to produce food, six acres each for every man, woman and child of our sixty millions of people ; and it is agreed that an acre and a fourth of well-cultivated land will yearly produce the food of an adult human being. The provoking cause of the vast emigration from the East to the West during the last twenty years has not been a natural one, the necessity of food or the disproportion between cultivable land and people ; but it has been the innate propensity of the Aryan race to rove and wander, which has been artificially excited for speculative purposes.

Adjourned to Wednesday, at 9.30.

SECOND DAY.

The meeting opened at the hour appointed, Mr. CRUICKSHANKS in the chair.

The CHAIRMAN. The lecture this morning will be on the "Economical Feeding of Dairy Stock," by Prof. W. W. Cooke of Burlington, Vt., Secretary of the Vermont Board of Agriculture.

ECONOMICAL FEEDING OF DAIRY STOCK.

BY PROF. W. W. COOKE OF BURLINGTON, VT.

In taking up the subject of economical stock-feeding, we shall treat it as including the whole system of the care of stock, from the planting of the crop to the putting of it into the mangers; for the economical farmer will find abundant chances for the use of economy in all the different stages in his care of stock. In order of time, the first chance for economy is in the determining what crops can be most profitably raised for fodder.

Our farmers nowadays do not need to be taught that farming to be profitable should use up on the farm the crops raised to prevent the plant food they contain from being carried off the farm; and they also ought not to need to be instructed that more profit comes from feeding what is raised on the farm than from feeding what is brought from outside of the farm.

In planning what crops to raise, the farmer needs to take into account, of course, the kind of stock, and the purpose for which he is going to raise the food, and get what is adapted to his purpose.

Most of the forage crops raised on the farm are useful for feeding to the dairy; but there is a wide difference in the cost of raising the same amount of feeding value in these different crops. This is a subject that has received too little attention from our farmers. They are too likely to judge of the cost of a crop by its gross weight, without regard to its feeding value.

In order to know the comparative cost of crops, we must know first the comparative cost of raising the crops per acre, then the amount raised, and this is as far as most farmers go into the problem ; but this is not far enough. If it costs the same number of dollars to raise two tons of hay and two tons of corn stover, we cannot say that one is as economical as the other. The two tons of hay may be dry and the corn stover wet. The water of course has no feeding value, and we must take that out of the weight before we can correctly compare the two feeds ; but, having done this, we are not yet in a position for a correct answer to the problem, for of this dry matter not all is digested, and the indigestible part, having no feeding value, must not be taken into account. We do not then arrive at the proper basis for comparison until we go down to the number of pounds of digestible material per acre in the different crops, as compared with the cost of producing them. We are then ready to calculate how many dollars it has cost to raise one ton of digestible feeding material in each of the different crops.

Most of the experiment stations have published tables which give the composition and the digestible parts of the different crops ; so that it becomes a mere matter of arithmetic for any one who knows how much it costs him per acre to raise the different crops to figure out the real cost to him of their feeding value, and which crops are for him the most economical.

The principal coarse fodders raised at the present time in New England are the various soiling crops, hay and clover, corn fodder, roots and ensilage. On subjecting these various crops to the above-mentioned calculation, it will be found that hay and clover are the cheapest, soiling crops next, then corn and ensilage, and lastly roots. In most places in New England pasture is still cheaper than any of these. But the question of pasturage is governed so entirely by the local condition of the farm that we may leave it out of account. The price of labor in New England is so high that roots are too expensive for general use, and we need therefore give them no further consideration; which narrows the problem of crops down to hay and clover, soiling crops, and the corn plant. Soiling as a system of stock-feeding is but little used in New England, and yet it deserves more attention than has been given it.

There are few farms that have such excellent pastures that the stock can be carried through from spring until fall without some supplementary feeding. It is a noteworthy sign of the times, that each year more and more farmers see the force of this remark, and make preparation for carrying their cows over the drought of midsummer and early fall. On many farms the pasture will carry the cows until the middle of August, and a crop of corn suitable for soiling can be matured by this time. Of all soiling crops corn is undoubtedly the best, where the crop is not needed until late enough in the fall to raise the crop; but it should always be remembered that the corn crop, to be valuable, must be nearly matured, and must be planted far enough apart so that it will ear.

For those whose pastures begin to fail early, some more elaborate system of soiling is necessary; and probably the most valuable crops next to corn are clover and peas and oats.

But a better method than resorting to soiling lies open for most of us, and that is winter dairying. This allows the cows to go dry during July and August, and therefore there is no need of supplementary feeding until a first-class corn crop is ready for them in September. Whatever addition to the pasture they may need during July and August, may be as readily supplied with hay as the more expensive soiling crops.

Many of our farms are situated so that they need to produce milk the whole year round. This will usually happen in the vicinity of cities, where land is high and pasturage expensive. What might be called a model system of economical stock-feeding for such conditions, would be the keeping of the cows off from pasture entirely, keeping them in the stanchion every night in the year, and allowing them a few acres in which to move around for exercising during the summer, using ensilage and grain twelve months in the year, and re-enforcing this with hay during the winter, and with green crops during the summer, the green crops to furnish about one-third of the ration in summer. Such a plan would be very economical of land, since, on this plan, land of medium quality will keep a cow to the acre the year round, and constantly increase in fertility with no outlay for commercial fertilizers. Having obtained the fodder, the next question that confronts the stock-feeder is, how and when to feed it. The when can be answered much more easily than the how.

A half-century ago the feeding of the stock used to begin the first thing in the morning, usually before five o'clock, and continue at frequent intervals until late in the evening. The frequency of feeding has gradually decreased, until at the present time it has been narrowed down to feeding either twice or three times a day. The tendency at the present time is very strongly toward omitting the noonday meal and feeding the cows only morning and night, allowing them a day of rest in which to remasticate and digest the morning meal, the same as they have always been allowed a night of rest for the evening meal.

At a recent meeting of the experiment station directors this question came up, and a census showed that nearly two-thirds were feeding but twice a day. The same remark applies to watering. Twice a day is sufficient in all cases, and where green fodder is given, once a day is usually enough. This allows a very economical use of the farmer's time. He can feed, milk, and clean the stables the first thing in the morning, and go about his other business for the rest of the forenoon; a few minutes spent in watering at noon, and he can leave them again until night.

As to whether warm or cold water should be given, doctors have decidedly disagreed. Many practical farmers adduce proof from their own experience that warm water pays. It is at least a noteworthy contribution to the literature of this subject, that, out of four stations that have tested the subject in the most careful manner, three have found no gain by warming, and the other a gain which, at the utmost, amounts to less than fifty cents per cow per winter. There is a growing belief, among those who have most carefully studied the subject, that the question is not one of warm or cold water, but rather of warm or cold barns. If the animals are well housed in good, warm stables, warming the water will be of no advantage. But if the barn is full of cracks, and the animals are compelled to drink out of doors and stand shivering in the cold afterwards, everything in the nature of warmth which can be gotten into them will show an effect. It would seem, then, to be more economical, as well as more humane, to spend the money that a heater would cost in putting building paper and clapboards on the barn.

The farmer, having now his cattle in the barn and his feed on hand for them, is confronted by the question, "How shall I mix the fodders so as to get the greatest return from them?" If we were to examine the rations of a large number of dairymen who are successful in their calling, we would find a wide diversity in the character and amount of the various articles used for fodder. But a closer investigation would show that there was but little difference in the real feeding value of these rations. Externally they are different, internally they are alike. To teach a person to feed properly, it is not necessary to teach him all the possible combinations of all the various feeding articles. The principles are the same for all kinds of feeding, and when the farmer has learned these principles, it will be easy for him to make his own combinations and suit his own circumstances out of whatever materials he has on hand. It is then to the principles of profitable feeding of farm stock that we will now give our attention.

Success in feeding depends on several things, no one of which can be said to be the most important, because each one is necessary, and if any one is lacking no success can be obtained.

Among these necessary considerations may be noticed: —

1. *The Feeding must be Healthful.* — This stands to reason. The cow is a machine, and to get good results this machine must be kept in good running order. But more is included under this head than might be at first thought. Feeds which are usually healthy may be improperly fed and

become injurious. We may give an excess of any feed and bad results follow, or we may make an improper combination of healthy foods and produce a bad effect. For instance, corn meal is an excellent feed, and cotton-seed is, also; and, chemically, the two would balance each other and make a perfect ration. But no farmer would think of feeding his cows exclusively on corn meal and cotton-seed meal, for he knows that each has a tendency toward producing a feverish state of the system, and each would aggravate the effects of the other, and so produce sickness. It has been found by experience that at least one-half of the grain fed should be of a character not to produce fever; among grains of this nature are shorts, bran, middlings, etc. If, then, one is going to feed three pounds of a mixture of corn meal and cotton-seed, he should feed with it at least three pounds of bran, middlings, ground oats, or something of that character. So, too, stock do better, or are better in health, when the ration consists part of green fodder and part of dry. There is little doubt but that the digestion is better and a larger return is given for the food consumed, when part of the ration is given in the green state. This is especially true if the production is being forced by giving large quantities of concentrated grain.

2. *The Animal must be Comfortable in all its Surroundings.* — Our present dairy cow is an artificial animal. The large quantity of milk, the long-continued flow, and especially the richness of the milk, have been developed in the animal through a long series of breeding and selection with that object in view. Now, if anything occurs that is disagreeable to the cow, she will show the effect, first of all, in that part of her organization which is most artificial; that is, in the production of milk. If she is chased by dogs, worried by flies, thirsty, or uncomfortable physically from any cause, the effect is seen at once at the milk pail. This effect is two-fold: there is not only a shrinkage in quantity, but, contrary to the generally received idea, there is a decrease in the quality of the milk given under these conditions. The general rule is, that when a cow shrinks in quantity there is an increase in quality. This is always true of that shrinkage that comes naturally as the cow gets

farther from the time of calving, especially if she be again in calf.

Under this same principle comes the fact that if the food of the animal is not relished the results cannot be good. The reverse of this is also true, that if a cow is very fond of what is given her she will give an unusually good return for it, considerably better than would be expected from its chemical composition. To the effects of these two elements in the problem of stock-feeding, the healthfulness of the food and its relish by the animal, may be laid quite a part of the good results obtained from feeding roots and ensilage. The best cattle feeders bear testimony that roots and ensilage are worth more to them in comparison with hay, grain and other dry fodder, than the comparative values given to them by the chemical analysis. It is at least a striking coincidence, though it may be purely accidental, that those feeds that are best liked by the cow are also best digested. The first green grass of the spring, roots of all kinds, corn fodder and all the products of the corn plant, foods which are liked by all animals, are about three-quarters digestible; whereas hay and clover are but little more than half digested, and straw still less.

3. *The Fodder must not be too Bulky.* — Clover hay, for instance, is in itself a perfect ration, and yet no one would expect a cow to produce two or three pounds of butter a day on nothing but clover hay. Large as is the digestive apparatus of the cow, it would not hold enough of clover hay to produce so large an amount of butter, and the mere work of eating and digesting so large a quantity would overtax the system of the animal. It has been found best, whenever a cow is producing heavily, to give part of the food in a concentrated and easily digestible form, and many of our best feeders think they are well paid for doing this the whole year round.

4. *The Fodder should be given in the Proper Proportion or Ratio.* — This is the part of the subject that most persons find difficult to understand. And yet there is nothing really difficult about it. We first consider the food as made up of two parts, the digestible and the indigestible. The indigestible we have nothing further to do with, we leave that

entirely out of account, and give our attention to the digestible part. This we consider to be made up of two portions, quite distinct in character and having different uses in the system: one part keeps up the natural heat of the body, and we call it the heat-producing part; the other builds up the system, makes the muscle or flesh, and is the chief instrument in making these muscles or this flesh yield us valuable productions, such as labor, speed, milk, butter, wool, etc. We call this part the flesh-producing or the force-producing part. It will be evident from these definitions that the amounts of these two kinds of food required by the animal will be determined by what the animal is doing. A full-grown ox, that is neither gaining nor losing in weight and is doing no work, has but little need of the flesh or force producing parts of the food. It is only existing, and needs to do but little more than keep up the natural heat of the body. We find an animal under these conditions to use principally the heat-producing parts of the food. Yet even then the animal will need some of the flesh or force producing part; for in the mere act of living the muscles are being continually worn out and need replacing, and all the actions of the heart, lungs, etc., require some force, and this force can come only from the force-producing part of the food. If, now, this ox is set to work, at once there is a demand by its system for more muscle, more flesh, more force. If we do not increase the amount of the flesh-producing material in the food, the animal cannot replace the worn-out flesh, and grows thin. All production, whether of growth, labor, wool or milk, uses up flesh in the animal; and so we can use the word *flesh* as including all these productions of the animal. This single example will serve to show the foundation of the principles of rational stock-feeding.

The animal has a certain work to do, this work will require the using up of a certain amount of heat and a certain amount of flesh; and we must supply in the food enough of the heat-producing material to make up the heat, and enough of the flesh-producing material to keep up the supply of flesh. If the food just does this, with no surplus, it is exactly suited to the case, and is said to be a well-balanced ration.

But you will see at once that a food that is just right at one time and for one animal would not be at another under different circumstances. A dry cow needs a certain small amount of the flesh-producing material to keep alive; as soon as she begins to give milk this amount must be largely increased; for the milk is as truly flesh as is the lean meat, and requires the same parts of the food to produce it. A young growing animal requires a larger proportion of the flesh-producing part than a full-grown one, and an animal working more than one standing idle. There is certainly nothing difficult about understanding this; it is just plain common sense.

Now, what are these two parts of the food? The heat-producing part is the part which most nearly resembles starch, sugar, gum, etc. The flesh-producing part is the gluten of wheat or corn, and that part of other foods which resembles gluten in composition. Chemically all these flesh-producing materials are the same as the albumen or white of an egg, and for that reason are called albuminoids. They are also chemically the same as flesh and the caseine of milk or the part that produces the cheese.

When we speak, then, of the proportion of a ration, we mean the relative amounts of these two parts, — the heat-producing and the flesh-producing. All fodders are made up of these two parts, but in widely different proportions. If the amount of heat-producing is large as compared with the flesh-producing, the fodder is said to have a wide ratio; if there is but little heat-producing, the ratio is said to be narrow.

From what has already been said, you will readily see that it makes a difference in what proportions the food is given. Farmers recognize the fact, though they may not know the reason. A milch cow requires a great deal of the flesh-producing food. No farmer would think of feeding a cow on nothing but straw, and expect to get a large yield of milk. He knows from experience that it will not produce flesh. The chemist analyzes the straw, and says that the digestible part consists principally of heat-producing material with not much flesh-producing, the proportion being about thirty times as much heat as flesh producing; or we say it has a nutritive ratio of 1 to 30, which would be called a very wide ratio.

On the other hand, under the same conditions the farmer would not think of putting a cow on nothing but linseed meal. The chemist says that linseed meal has a narrow ratio, the heat-producing and flesh-producing parts being in the ratio of 1 to 2.

We see, then, that by making a combination of fodders which have a wide ratio with those which are narrow, the farmer can make any proportion he desires.

For every animal and every condition there will be some proportion that will be best; and it will be that proportion which just supplies all the needs of the case, with no waste. This is of course self-evident, and so long as the conditions remain the same, the proportion that is proper will remain unchanged. No one will dispute this; but he may not feel so certain of the statement, which is nevertheless true, that when you have found the correct proportion for a given animal for a given kind of work (whether growing flesh, doing work or producing milk), that proportion will be correct for all like animals and for all like work, without regard to age, breed or time of year. To be more explicit, this means that if a certain ratio between the heat and the flesh producing parts of the food has been found to be best for a certain milch cow, we can argue from this that it is also best for all milch cows of all breeds, all ages, all times of the year, and whether the product desired be milk or butter. Let us make this last statement a little plainer. There are many intelligent farmers who claim that the cow should be fed differently to produce a large flow of milk than if the desire is to get a large amount of butter. They say you should feed bran, brewers' grains, buckwheat middlings or something of that nature in connection with succulent foods like roots, ensilage and soiling crops, to produce milk; while if butter is desired, corn meal, ground oats, linseed and other so-called heavy feeds must form a large part of the cow's food. Nevertheless, a close examination will show that the most successful feeders for milk are using the same proportions of heat and flesh producing materials as their brethren who are striving to break the record of a seven-day test for butter. A glance at a table of the chemical composition of feeding stuffs will show how this can be. It will then be seen that ensilage and corn meal have about the same ratio, brewers' grains and linseed meal but little different, roots and cotton-seed meal not nearly so different chemically as one would suppose from their opposite physical properties. And, judging from the chemist's stand-point, there is no reason for thinking that the cow desires any different food from which to make a large flow of milk than to produce largely of butter; both the milk and the butter are first produced as flesh in the cow's body, and are then liquefied. In each case they want a food that will produce flesh. Parenthetically, I might add that I do not take much stock in the feeding of cows differently for milk than for butter, since I believe that the individuality of the cow is the leading factor in the case, and the feed is subordinate.

Provided the food is healthful, that it is relished by the animal, that it is of the proper bulk, and that the proportions of its digestible parts are right, it makes no difference from what source this digestible part is obtained. That is, a pound of digestible flesh-producing material from corn is just as valuable as a pound of the same material from hay, and no more so. A pound of starch from cotton-seed meal has the same feeding value as the same quantity from ensilage. Digestible woody fibre is the same, and has the same feeding value in all fodders. There is one exception to this, however, in the case of the so-called fat, or that part of the fodder which is soluble in ether. That extracted by ether from grain is a true fat, and has a high feeding value, while what a chemist calls fat from a coarse fodder is quite largely coloring matter, and its feeding value is probably small. But, in general, we can say that a pound of digestible heat-producing material under like conditions has the same feeding value, no matter what its source, and the same is true of the flesh-producing.

So far we have named the considerations which would hold true in regard to the proportion that is best for these two parts of fodder, the heat-producing and the flesh-producing. We now come to the question as to what that proportion is that is the best. A great deal of study has been put upon this point, and it has been determined what proportions are the best for many different kinds of animals, and for these animals under different conditions. We will take for an example the milch cow. It has been found that if you feed a large number of cows of the same natural capacity, or feed the same animals at different times on rations that differ in the proportion of their parts, ranging from a very wide ratio to a very narrow one, as the ratio becomes more and more narrow, until it gets to one in which there are about five and one-half parts of heat-producing to one part of flesh-producing, it takes less and less food to yield one pound of valuable produce, milk, butter, etc. If you go on still farther, and give a ratio narrower than that, you soon come to a ration which proves unhealthful to the animal. This would seem to indicate that the best proportion was one part of digestible flesh-producing, to five and one-half parts of digestible heat-producing, material. This is what is variously called the German ration, or the German feeding standard, or the theoretical ratio for milch cows. Why it should be called theoretical does not appear, for it is just the opposite of this. It is eminently practical. It is a result arrived at, not by theory, nor by reasoning, but as a result of many hundreds of carefully planned and executed feeding tests at many different times, and by a large number of different individuals. This proportion corresponds closely with that in many foods which we all know to be first class.

The question naturally rises, What is the effect of feeding rations not properly proportioned? If the ratio is too wide, which means too large a proportion of the heat-producing for the amount present of the flesh-producing, wherein does a loss occur? In this case there is simply a loss of the extra heat-producing material, which is principally starch and sugar. There is no injury to the animal, unless the ratio becomes so wide, and the amount of flesh-producing material so small, as not to give the animal all it needs for its own sustenance; and long before this point is reached the animal will have shown by its behavior that something is the trouble. If, on the contrary, the ratio is too narrow, there is not only a loss of the extra flesh-producing material, but there is danger to the health of the animal, since this extra albuminous material is a rank poison if not eliminated from the body.

So far for the theoretical principles of feeding. Now, turning to the practical, we find that in market the flesh-producing part of the food costs more per pound than the heat-producing. We want, then, to feed as little as possible of the flesh-producing, and as much as possible of the heat-producing; we want to strike the balance where we can get the most production for the least money. We should endeavor to get as much as possible from what we feed, and at the same time to feed what is cheapest. These two desires work in opposite directions, and, as just said, the aim should be to strike the most profitable balance between them.

Most of the crops raised on our farms are deficient in the flesh-producing material. Clover, peas and oats cut green and early, barley in the head, Hungarian in blossom, rye just before heading, and pasture grass, are about the only things raised on the farm which have this ratio of one to five and one-half. The cheap foods, such as hay, corn fodder, straw, ensilage, etc., are all too wide. It is the fundamental principle of cheap feeding to raise as much as possible of the fodder upon the farm. Hence the farmers should endeavor to largely increase the amount produced of the articles just mentioned, as being in themselves correctly proportional. This is especially true of clover, which ought to be one of the foundations of New England dairy farming. Enough attention has not been paid to peas and oats as profitable farm crops, whether cut and made into hay, or put into the silo.

In any system of farming the bulk of the material raised will have too wide a proportion of its parts, hence whatever feeding stuffs the farmer buys should be of the opposite kind, that is, of a narrow ratio. When our farmers find themselves in need of grain to help out and balance up the supply of hay and other coarse fodder that has been raised upon the farm, the chances are that when they go to the mill or the feed store, the first grain they call for will be corn. But corn has just as wide a ratio as hay, and instead of helping the difficulty they have only added to it. It is true that the animals like the corn, and if given a sufficient quantity of it will yield a fair amount of product; but this product is obtained at the expense of a waste of considerable of the starch and sugar contained in the hay and corn. What the farmer should buy in the place of corn meal, or at least in the place of most of it, should be something with a narrow ratio, such as bran, cotton-seed, middlings, oil meal, gluten meal, etc.

The price of these different grains, and the nearness of the farmer to the source of the supply, has a powerful effect on the proportion which will be the most economical for him to employ. Corn in its various forms, that is, as grain, dry stover, dry fodder corn, green fodder corn and ensilage, is undoubtedly the cheapest source of animal food which we can grow in this climate, next after hay, which we all know is the cheapest feed. A ration to be profitable, then, must be composed very largely of these fodders, and it will therefore be wider than the German standard. Whatever we buy and bring in from off the farm should be of such a nature that a small amount of it will balance up, to make a perfect ration, a much larger amount of the cheapest fodders which we can raise on the farm; that is, they must be rich in the nitrogenous or flesh-producing material. Such materials are found in linseed meal, cotton-seed meal, gluten meal, bran, middlings, brewers' grains, buckwheat middlings, and several others of the by-products or refuse material from various manufactures. We have said that a ration of wider proportions than the German standard would probably be a cheaper ration than one as narrow as the German desire. Let us calculate the cost of some rations, and see how it would be. Taking prices as they are at the present time, we may consider hay worth $8.00 a ton; good corn fodder, $5.00; corn meal, $20.00; cotton-seed meal, $26.00; and bran, $20.00. To make a full day's ration for a cow weighing a thousand pounds, according to the German standard, would require nine pounds of hay, nine pounds of corn stalks, four of bran, four of corn meal, three of cotton-seed meal. This would cost at these prices 17.75 cents. To make the same ration on a basis of 1 : 7 instead of 1 : 5.4, would require twelve pounds of hay, twelve pounds of corn stalks, two of corn meal, one of cotton-seed meal, two of bran; and this would cost 13.10 cents, making a difference in favor of the wider ratio of 4.65 cents per day, or $9.30 per winter-feeding period of two hundred days. It is not to be expected that the cheaper ration will produce so large an amount of milk as the more concentrated and costly ration; yet it is doubtful whether the increased amount of milk would pay for the increased amount of cost.

But it will not do to make this rule of feeding too general, — to think it will fit all cases. A man can raise corn for some less than $20.00 a ton; neither his corn stover nor his hay ought to cost him those prices for production. The nearness to the railroad is another important factor. As we get back into the country, the value of the produce raised on the farm decreases and the cost of bringing in grain from outside increases; so that what would be a paying investment to the man near the railroad would be a losing one to his neighbor back in the mountains. Another class of farmers would also prove an exception to this rule, and that is the milkmen. They get such a large price per pound for their milk that they can afford to pay a larger price for the feed which they put into their cows, and with them it pays to feed high and keep the cows producing almost to the utmost limit of their capacity. A milkman should feed, and, as a fact, most milkmen do feed, very close to the German ratio. And still another class would prove an exception to the rule, and that is those farmers who are trying to keep more stock than their farms will carry, and who must necessarily, therefore, buy a large quantity of food. It will pay better for them to buy principally of the concentrated feeds, and give their animals a ration very close to the German standard. It will be seen, then, that no set rule of feeding can be laid down for the various conditions of farmers. The probability is that milkmen should feed a ratio of 1 : 5.4. Those living near a railroad and having plenty of land to produce about all that their stock need, should feed a ratio of about 1 : 6.5 or 1 : 7; and in general the farther back we get from the railroad the wider the ratio to be most profitable, until back in some of the hill towns it is undoubtedly true that the cheapest ration is the one we find them so generally using, viz., hay and corn meal, both of their own raising; though this would seem on first thought to be a very one-sided and unphilosophical ration.

What has been said may be summed up as follows: The farmer should raise as much as possible of what he feeds; he should determine by careful figuring what crops are most economical for him to raise, and not leave this important point to guess-work. He should use soiling crops so far as they may be necessary to keep up the flow of milk, since the cows should under no conditions be allowed to shrink any more than is natural before going to the barn for the winter. They should stand in the stanchions every night in the year. They should be fed twice a day, and watered once. Instead of paying out money for warming water, spend the same amount, or more if necessary, in making the stable warm. The feed given should be healthy, the animal should be comfortable, the feed relished; it should not be too bulky, and should be given properly proportioned, attention being given in this last regard to the condition of the farm, nearness to market, etc. He who will conscientiously carry out these details, and bring to his work the same business methods and care as are used in other callings, will never need complain that "farming does not pay."

The Chairman. I notice quite a number in the audience who are milkmen and dairymen in this and the surrounding towns. It must be that many questions have sprung up in your minds that you would like to have the lecturer answer. You are now invited to put any questions. We have only about an hour, and I hope you will start the wheel rolling, so that Professor Cooke will be able to improve the time as far as he can.

Question. He feeds twice a day; why does he not water twice a day?

Professor Cooke. I suppose there are some herds which will take water twice a day. I have been at some places where they watered twice a day, and I was told that the animals drank well both times, — night and morning. In those cases I found that they were fed entirely dry feed. Now, you will notice that I have recommended that the feed be partly dry and partly green. I think, if you are feeding your cows thirty pounds of ensilage a day and the same amount or more of soiling crops, or if you are feeding both ensilage and apple pomace, as we are at the present time, say ten pounds a day of apple pomace and from twenty to thirty-five pounds of ensilage, — you will find that the cows will drink in a single time all that they need for twenty-four hours, and if led up to the water a second time only a few of them will drink, and they will merely stick their noses in. I don't think you get enough gain from the extra watering to pay for the extra time and trouble expended.

Question. May I inquire the ratio that apple pomace bears to good fodder?

Professor Cooke. You mean as to its heating and flesh-producing qualities?

Question. Yes, sir.

Professor Cooke. I should have to give that from memory. I should say it stands about as one to ten; that is, about the same as ensilage. Its chemical composition is not very much different from that of ensilage. Its feeding value, I think, is fully equal to that of good ensilage.

Question. Don't you think that if you feed a large herd of dairy cows without giving them water three times a day a great many of them will shrink in the amount of milk produced?

Professor Cooke. I should say no.

Mr. Waters. I have found that when I fed ensilage and roots in the morning, cut fodder and oats at night, and hay at noon, and did not water them three times a day, they shrank in milk.

Professor Cooke. They probably would shrink, at first. A cow will shrink in milk whatever change you make. Any change that upsets the natural run of the system will make her shrink at first. If a cow is watered once a day for a year, I think the product at the end of the year will be fully as great as if she were watered twice a day. The animal will adapt herself very easily to any regular system under which she is fed.

Mr. Waters. Yes; but my experience has taught me that a cow that is watered twice a day will give more milk through the season than she will if she is watered but once. It does not make any difference whether you are feeding all dry feed or feeding ensilage and roots. A cow fresh in milk will drink more water if fed with dry feed than a cow that has been giving milk for eight or nine months; and invariably fresh-milch cows will drink twice a day, and generally three times a day.

Professor COOKE. We have repeatedly tried our cows, to see whether they would drink even a second time. It is very seldom that we can get them to touch water a second time.

QUESTION. Can you tell us the aggregate of the milk in the experiment you referred to?

Professor COOKE. I cannot. We only finished that experiment about a month ago, and have not written up the figures yet; but I have looked at them sufficiently to be able to say that there were cows on both sides. I can give you a little account of another experiment, which has been written up enough so that we do know the result. That was an experiment in changing from hay to pasture. I think every one who has written on this subject — at least, so far as I have been able to find — has claimed that when a cow goes out from the dry feed of winter to pasture there is an increase in the amount of milk and a decrease in the quality of the milk. To see whether that will hold in all cases, we tried it on eleven cows last spring, and we found that in the aggregate it would hold; that there was quite a decided increase in the aggregate amount of milk given, and there was also a decrease in the quality, — not very large, not so large as we had expected, but there was in the aggregate a decrease in the quality. But the increase in quantity more than overbalanced the decrease in quality, so that there was in the aggregate an increase in the amount of butter produced. But when we came to analyze, we found that some cows were on one side and some on the other; but the cows that were on the negative side were a good deal more than overbalanced by those on the affirmative side, so that the aggregate resulted as I have said.

Mr. HICKOX. Can those who sell the better grades of butter tell when bran or Indian meal has been fed? It is said that they can. I should like to have the speaker explain that.

Professor Cooke. One of the best explanations of that occurred about two years ago. A large dealer in Boston was handling a great deal of butter, and he had made up his mind very strongly that whenever ensilage was fed to cows the quality of the butter was injured, and he was also very sure that he could tell when the ensilage was being fed. One of the best butter makers who sold his product to him was a person who is now a member of the Vermont Board of Agriculture. He was in Boston one day, and they got to talking on this subject, and the butter buyer said: "Now, I want you to remember not to feed any ensilage. Don't you be carried away by this ensilage craze. Your butter is now about as near perfect as it can be, and I don't want you to spoil it by feeding ensilage." Now, that man had had a silo for several years, and the butter that the butter buyer was talking about was made on a very heavy feed of ensilage. I think when you point the moral of that you will get the answer to your question.

Mr. Hickox. This story was told me as a fact. A gentleman near the city of New York was making fancy butter; his son was on a farm, and sent his butter to the same market. Word came to the young man that his butter was not up to standard in quality, and he must stop feeding ensilage. The fact was, that the young man had not begun to feed ensilage. He opened his silo immediately, and went to feeding ensilage, and when he got word from the market again the butter was all right. So much for ensilage, so much for Indian meal, in the cow's rations. Now, tell me, if the cow's ration is balanced in the different proportions which you speak of here, is not that the secret of the whole thing in regard to the quality and quantity of the milk?

Professor Cooke. If your cow is a good cow, and you give her a fair chance, she will do well by you; but if you do not give her enough food, or give her a badly balanced ration, she cannot give you a good product.

Mr. Goddard. In the town where I live we have a man who has made fancy butter and sent it to Boston for some years, and received a fancy price for it. The party to whom he sent his butter used to be prejudiced against feeding cotton-seed meal. At one time the butter maker got word from the party in Boston who was buying his butter that he must not feed any more cotton-seed meal, — that his butter was not so good as it had been. That man had never fed any, while I had been feeding it right along and sending my butter to the same firm, and never had trouble. I know a gentleman who is very much prejudiced against ensilage, who buys his butter of one of his neighbors and pays a high price for it. One day the son of the neighbor was up to the gentleman's place, and he said to him: "Tell me as soon as you commence feeding ensilage, and I won't have any more of your butter." The young man said, "All right." He went home and told his father what the gentleman had said, and his father told him not to tell him when they commenced feeding ensilage. He opened his silo and fed the ensilage to his cows, and the gentleman kept on buying his butter. Some time afterwards this gentleman asked him when he was going to open his silo. "Why," said he, "I have been feeding ensilage for three or four weeks." The gentleman's wife spoke up and said, "Didn't I tell you the butter had been better than it was before?"

Mr. Woodson. I have been in the habit of feeding differently for milk and butter. I have always supposed that I must. It looked reasonable that Indian meal, cotton-seed meal, etc., would make more butter in proportion to milk than shorts and that kind of feed. I tried no experiments to find out whether it was so or not until last spring. One reason was, that in making butter we set the milk in large and small pans, and churned two or three times a week, and churning so seldom we did not have a chance to experiment so readily as we would otherwise. Now we are using Cooley cans, and churning every morning and night; and when we got those I began to experiment to find out the difference between feeding different kinds of meal, shorts, cotton-seed meal, and so on. I found I got the same number of spaces of cream every time, — it did not make any difference what meal I fed. The only time I have seen any difference throughout the season was when I turned my cows into fall feed for an hour in the morning. I found there was quite a change in the quantity of cream in proportion to the milk.

QUESTION. Increase, or decrease?

Mr. WOODSON. Increase of the cream. That was the only instance where I could see that the feed made any difference; and there I got some three spaces more of cream on about eighteen quarts of milk than I did the day before I turned them in. After I took them off of the fall feed they gradually came back to the ordinary amount of cream. The speaker said that probably nine-tenths or five-sixths of the farmers would have said that it would be different, and six months ago I should have voted on that side; but I take ground with the speaker to-day. I may change my mind later, but I think he is a great deal nearer right than I should have thought he was six months ago, before making these experiments. As I say, by using these cans and counting the spaces every morning, having the same cows and having the cans full of milk, I can tell the proportion of cream to milk; and the result has been the same with me as with him. Therefore, the more milk I can get the more cream I get. There is one point, and only one, upon which I should differ with the speaker; that is, in regard to watering cows. I have been in the habit of watering twice a day. Of course they do not drink as much when feeding upon ensilage, but my cows drink every morning and night. They hardly ever miss drinking twice a day.

Mr. SCRIBNER. I noticed that the speaker spoke of using cider pomace. I would like to know if it is used by any one enough to enable him to tell us whether it is practicable to use it or not. In 1886 I had three Jersey cows that had been fed upon ensilage and good meadow hay, and watered twice a day. I took away one-half of the ensilage, and fed cider pomace. They gained steadily, and gave more milk right along.

Professor COOKE. That would come under the same head with what has been said before, on the question whether the feed of cattle changes the character of the milk. I am considered rather a heretic in the views I entertain on that subject; but having put in, as we did for experimental purposes, various breeds of cows, and cows coming from different parts of the country, so as to get all sorts and kinds, we find that the individual or the animal so overshadows everything else that we cannot tell whether a particular kind of food given to anything but a pure-bred Jersey cow will produce a change or not. So far as anything we can come at to-day is concerned, it will depend upon the cow rather than the feed.

Mr. Bradley. I am surprised that the professor advocates feeding cows only twice a day. That may do for stock animals, but for milch cows I hardly think experience would bear out his statement. We are all striving here to get at facts. Now, I know that in forcing cows, as we call it, to get the greatest result, they feed four or five times a day, in small quantities; and now they have carried that to such an extent that they feed a cow fifty or sixty pounds a day to get the largest results. Would the professor recommend feeding that, all at two feeds, giving a cow thirty pounds at one feed; or would he recommend dividing it up, I will say, into four feeds?

Professor Cooke. Of course in that case you would have to divide up the feed; but if you consider that the amount you put into an animal must bear a certain relation to the amount of product gotten out, you will find that the stuffing process is not economical farming; and of course what I was talking about this morning was "the *economical* feeding of dairy stock."

Mr. Bradley. The question which arises in my mind is this: If the principle is applicable in one case, why is it not in the other?

Professor Cooke. Well, why not apply the same thing to us? It is not so very long ago that that system of feeding was, as I said, extended over the whole day. They began at five o'clock in the morning, and kept the cow eating all day long. Now, in what condition would our systems be if we should adopt the same practice, — if you, for instance, before you went out to milk, should stop and take a bite, and then come in to breakfast; stop your work in the middle of the forenoon and take a lunch; take your dinner at noon, and so on through the day; and after you got to sleep at night your wife should wake you up and give you some doughnuts and cheese to end off on? It is just the same principle. We find that our cows are not heavy feeders. If we compare the rations that our cows eat with those that are eaten by other animals, I think we may safely say that our cows are light eaters. They take their two rations a day, and we do not feed them any more than they will eat up clean, so that there are but a few ounces left of the twenty-four hours' feed. The cow takes that ration, and has all that time to digest it and get the most out of it. If anybody wants to go to the extra expense of labor and time in feeding often, I have no objection at all to their doing it. They have a perfect right to their own way of feeding. I was merely giving the profitable and economical way of feeding animals.

Mr. HILDRETH. I would like to inquire for information about feeding cider pomace. I have tried that to my satisfaction. I have found out that there is a difference in cider pomace as to how new or how old it is. If you want your cows to keep up their flow of milk, beware and not use any old, sour cider pomace.

Professor COOKE. I do not think there is any need of having any sour cider pomace, because it keeps perfectly wherever it is packed. We first put it into our silo, which was made rather better than the ordinary silos; it kept perfectly there. Then we made just a rough silo; that is, we took one corner of the barn and tacked building paper against the sides, and built out the two sides with ordinary boards and put building paper on the inside. We put the pomace into that, keeping a man in there to tread it down just as hard and close as he could. Then when we got through we put building paper, boards and weights on top, and let it stand for about three weeks, until it had compacted and the air was all pressed out. Cider pomace packs together very much more closely than any green ensilage, and after it is once packed it keeps almost indefinitely. This was just as good last spring as when it was put in. We could see practically no change during the winter.

Mr. BRADLEY. We are told here that feeding young corn before it is matured is not economical. Professor

Goessmann, at a meeting of the State Board last winter, made the same statement. Now, when our pastures get very short in July, having raised sowed corn for feed, we feed it a little sooner than the professor would advise, and we find that there is at once a very large increase of milk. If we wait until it is in a state of perfection, the frost comes so soon that we can use very little of the product for soiling, so we are obliged to feed it earlier. After frost comes we have practiced feeding cider pomace direct from the mill, and cabbage also. We raise from one to three acres of cabbages with that in view. Then, if the market calls for the heads at a paying price, we sell them and buy some concentrated food; if the price is very low, we feed them to our cows and young stock. I have found cabbage the best green feed that we raise on the farm. After the silo is filled, instead of using weights for it, I pile on all the apple pomace I can get, and it answers in place of weights; and by adding to it from day to day, directly from the mill, it is pressed down very solid, and will keep perfectly, with the exception of a little on the surface. There is no souring, as has been represented here.

Mr. GODDARD of Barre. I think this difference in the ideas of gentlemen about feeding twice or more times a day is more apparent than real. I remember very well when my father used to begin at five o'clock in the morning, and feed the cattle from time to time until nine o'clock at night. But some twenty years ago we began to hear of "the Barre system of feeding," because it was said to have originated in Barre. It was feeding twice a day, instead of a dozen times. It was not, however, giving the cows all their feed at two feedings. Mr. Ellsworth, the gentleman who is credited with originating the Barre system, gave his cows five fodderings a day. He gave them grain and two fodderings in the morning, and that was called one feeding; in the afternoon he gave them grain and three fodderings, and that was called another feeding, which made two a day. The cows were kept eating from the time the first foddering was given them in the afternoon until they had consumed the third, making two feeds a day. That is what I practice at home. I call it feeding twice a day. Then, with regard to watering, I think that is a matter which is governed a good deal by circumstances. There is something in the individuality of the animal, but a good deal in the habit. I have found, in my limited experience in feeding cattle, that they will acquire habits just as people do; and I think a great deal more depends upon the regularity of the feeding and watering than upon the number of times they have food or water. I think, also, that the same thing will apply to the process of milking. I want my cows milked about the same time in the morning every day and the same time at night. Some of the best farmers in our town milk their cows three times a day, — at four o'clock in the morning, at eight in the evening, and once between. I would feed and water and milk at regular times; and very soon the cows will become accustomed to it, and expect that at a certain time they will be attended to. Meantime, they are quiet, and spend the time in ruminating or chewing the cud. In regard to watering, I will say that I have tried various ways. The last two winters I have watered my cows only once a day. The water comes from wells, and is not very cold. I do not take the trouble to warm it, and think it would not pay to do it. I have tried watering my cows twice a day, and I found that some of them would drink in the morning and some in the afternoon; but I did not find that any of the cows would drink any amount twice a day. So I have adopted the practice of watering once a day, and every cow drinks regularly and just about so much every time; and then they go and lie down, and I do not disturb them until it is time to feed them.

QUESTION. How often do they have salt?

Mr. GODDARD. Once a week.

QUESTION. What temperature of water is best for milch cows?

Professor COOKE. Will you tell? I cannot.

Mr. PETERSON. You would not like to have your cows drink ice-cold water even in a tight barn, would you?

Professor COOKE. You just make this experiment. If your cows have been wintered in a warm barn, — not a hot barn, but a reasonably comfortable barn, — along in January just go through your whole herd and set two pails of water in front of each cow, one at the point of freezing and one at say sixty-five or seventy degrees. You probably will find that the cows are divided; some will prefer the cold water, and some will prefer the warm. We do not warm the water for our cows. It gets down pretty well towards freezing, but we never have anchor-ice in it, because it is in the barn. I see that at stations where the experiment has been tried with the utmost care, giving cows water at the freezing point for weeks, and then changing to water at from sixty-five to seventy degrees, they find very little difference in the product of the cows.

Mr. PETERSON. Do you think that in the production of milk anything is gained by scalding or wetting the grain?

Professor COOKE. I suppose it is rather late to discuss the question of scalding feed. I think it has been pretty thoroughly settled that the cooking of feed in any way, shape or manner decreases the digestibility of it, and is done at a financial loss. As to the question which produces the best results, giving the feed dry or giving it wet, I am inclined to say that I do not think there is much difference between them; but I would not want to decide one way or the other. Our method is to scatter the grain over the ensilage, and, the ensilage being moist, the grain sticks to it, and becomes moist. I think it has been pretty definitely settled that any added warmth to the feed is not a help, and in almost every case there has been an actual detriment.

Mr. WATERS. Mr. Goddard says he has tried watering once a day and twice a day, and found that his cows did as well when watered once as they did when watered twice. I would like to ask him at what time he watered his cows. I have found that cows, like human beings, want something to drink after they get through eating. My experience has taught me that if a cow in milk is watered twice a day, she will do better than when she is watered but once.

Mr. JAMES S. GRINNELL of Greenfield. I have been exceedingly sorry to hear some of the remarks which dropped from our instructor. They shattered my idol. If any experiment station will put forth the dogma that warm water is no better for making milk, is no more conducive to the health of the cow, than cold, I have lost faith in that experiment station. When an experiment station tells me what constitutes a proper ration, what is nitrogenous and what is non-nitrogenous, and how to mix them, I am willing to take their word; but I will not take any experiment station's word that tells as a fact what I know to be untrue. And I do know that the warming of water improves the quality of the milk and is better for the cow. I have not had great experience in this matter; but some seventeen years ago I put in a heater (the water was not cold before), and the quantity and quality of the milk was vastly improved. A friend of mine, one of the best farmers in Franklin County, carried the water from his house to his barn, and he told me that the amount of milk from his cows after they had warm water to drink was actually increased ten per cent. He said the cows would struggle to get to the place where the hot water came up. Have we not always been told that the drinking of cold water lowered the tone of digestion in our own stomachs? True, we are not cows, we have not as many stomachs as a cow has; but when we take cold water into our stomachs I think almost everybody's experience is that it checks digestion, while warm water makes our food more digestible, and improves the general tone of the system.

Mr. Woodson. I have had a little experience in warming water for the dairy. Last year I put a heater into my house, so that I could warm the water for my cows any time I pleased. I began heating it to about seventy degrees, and the cows would not drink it. Then I heated it to a lower temperature, and some of them would drink it and some preferred cold water; but I got no increase of milk or butter. I think the lecturer has got the right idea. If you have a cold barn, and want to warm your cows up, you had better give them warm water; but if your cows are in a comfortable barn, I do not think you will get any great gain by giving them warm water. When water gets down to thirty degrees, I have no doubt that it would be a good idea to warm it a little; but still, as I said, I saw no difference in the product of the cows whether the water was warm or cold. I don't think ice water would be as good for cows as some a little warmer.

Mr. Fitch. I want to ask why it would not be as well to feed the oats as hay, and thus save the expense of cutting them for the silo.

Professor Cooke. We have put peas and oats into the silo both cut and whole. I do not see that there is any particular difference in the keeping or eating qualities in the two methods; but we have found that our cows will eat peas and oats greedily in the form of ensilage, and they do not seem to have much of a hungering after them in the form of hay.

Mr. Fitch. Two stations on a certain railroad on the 26th of April last furnished 1,200 cans of milk to a contractor in Boston. The cows were put out to pasture from the last day of April to the 25th of May. On the 23d of May they sent in 3,520 cans from practically the same dairies. If you should go to that place and ask the farmers the question, probably every one would say that it made an immense difference when his cows were taken from dry feed to pasture. One more point. The lecturer said the cows to which he referred shrank in quantity and increased in quality. Then, when he spoke of the experiment of twelve milkings, he said that the difference was on account of the individuality of the cow, and he made the statement in the course of his remarks that some cows gave more milk and some less on what was considered poor feed than on the highest quality of feed. That went to prove, it seemed to me, what he had just said, that it was the individuality of the cow rather than the feed which produced the result, carrying out his principle. But it strikes me that if it is the individuality of the cow, twelve milkings are by no means enough to give us a fair test.

Professor Cooke. If you will excuse me for interrupting you, I did not mean that we fed it only for twelve milkings, but that at the end of the period of feeding we analyzed the milk from twelve milkings all combined, so as to get the average composition. It was fed for a much longer time than that.

Mr. F. D. Douglas of Whiting, Vt. The time has been when it was supposed that any one could be a successful dairyman; that it did not require any head work; but any one who has noticed the progress of this discussion must have seen that here is a wide field for thought and investigation. I know of no business where there is such opportunity to do brain work as in this. There are so many conditions that may come in to influence the result, that we need to guard every point. Take this matter of warming the water for our cows. What are the facts? Professor Cooke and I have met before in the discussion of this question. He knows that when he says, without qualification, that it does not pay to warm water, he is holding out a red rag to me. I contend that under some conditions we want to warm the water that our cows drink. In my own case I have a spring, but my herd is so large that it does not furnish water enough for them, and I have a reservoir from which to water my cows during the day. In the coldest weather of winter the water will be much below thirty degrees, and at such times I warm the water. Now, reason teaches me, experience teaches me, that I get more milk and more butter with warm water. So I say, under certain conditions we must warm the water. Under the conditions in which I am situated I must warm the water. I enjoy going to the house where the furnace is, and looking at my cows. The cows will stand so thickly about the trough as to crowd each other. Let that water get cold, and some of the cows will go away without drinking, will not drink once in forty-eight hours. Now, shall we take stock in the statement that under no conditions should we warm the water that our cows drink?

Professor Cooke. I did not state that in my paper. I said that if cows were watered outside, if they were kept in a cold barn, anything in the nature of warmth which we could put inside of them was an advantage.

Mr. Douglas. Another point I want to touch upon. When I commenced dairying, some twenty or thirty years ago, I was foolish enough to change my cows from dry feed in winter to green feed in spring. I found an increased flow of milk, but I found it took more milk to make a pound of butter. I doubt whether a dairyman can afford to feed his cows with a view to getting an extra flow of milk. He may do it for a short time, but in the end I do not think it will help him.

Then in regard to ensilage. It all depends on the quality of the ensilage. It is beyond question that sour, ill-smelling ensilage, fed to excess, injures the milk product; but there is no doubt that sweet ensilage improves rather than injures the butter.

Then in regard to cotton-seed meal. Perhaps somebody will ask, "Do you feed cotton-seed meal?" Most certainly I do. "Does it not injure your product?" Certainly not. It is a very highly concentrated food, and if I should feed my cows heavily with it, it would injure their digestive organs. So it is with a great many other things. There are so many conditions that it will not do to lay down any arbitrary rule for dairymen. We must look over all our conditions, and make rules carefully and considerately, and then be guided by them.

Mr. Lord of Otter River. I am not going to controvert the essayist at all, for I think he has given us an excellent essay; but I want to say some things which he did not say. I will speak first about watering stock. I am not sure, for I never tried it, that a cow will drink three pails of water in a day; but if she will, would it not be better that she should drink it at three different times during the day instead of drinking too much at a time? I am not going to say whether that is so or not; I simply make the suggestion because it has not been brought up.

There is one thing I want to say about ensilage. I have heard it said that by analysis five tons of ensilage were equal to one ton of good English hay; but by experiments in feeding it has been shown that three tons are equal to one ton of good hay. Now, we need to look into that a little and get some facts. Ensilage is sour, it is an acid, and natural science teaches us that acid in the stomach will change starch into sugar so that it will be digestible, and if there is not too much acid in a substance we do not taste it, and of course it is of no account. Then, where people feed ensilage they feed a great deal of meal, and all our grains, if I am right, contain about fifty per cent of their weight of starch; and if there is not acid enough in the stomach, then this acid in the ensilage which the cow eats helps her to digest the meal. So it will be with apple pomace.

Then I wanted to speak of the physiological structure of the cow. The cow is very peculiar in regard to her digestive organs. All animals which chew the cud have four stomachs. Their food passes through three. It passes into the first stomach, which is called the *rumen*, and hence a cow is called a ruminating animal; and after that the grass or fodder goes into the *reticulum*. It lies there until it has fermented and got into a sort of pliable state, and then the cow raises it. She chews her cud; she cannot help it; it is her nature to do it. The operation of nature forces so much up into her mouth, and she chews it. When she swallows it, it does not go into the *rumen* as it did before; the grass or fodder pushes aside a valve which closes the aperture of the first stomach, and when she swallows it the second time it passes into the second stomach, and from there into the third and fourth. Now, when a cow is fed grain, it should be wet, because it will then be put into a condition where the cow will digest more of it; and she will give more milk if fed in that way than if fed dry grain. That is why steaming fodder has been thought to be an advantage sometimes, because the grain was fed with the coarse fodder and it went into the *rumen* and remained there until it was in a better state to be digested. Now, since people have found out these things about the cow, they have begun to think that all the good they got from steaming coarse fodder was that their cows would eat it. Perhaps I did not explain quite fully that there is no way by which the cow can get this coarse fodder out of the *rumen* and into the second stomach except by chewing it over in the cud. For that reason she should be fed but twice a day. She needs the middle of the day as well as the night to chew that over. There is no outlet for it except to come back into the mouth and be chewed over and swallowed in another direction. So that I claim that twice a day is enough to feed a cow.

Adjourned to one o'clock.

Afternoon Session.

The meeting re-assembled at 1.30, Mr. Cruickshanks in the chair.

The Chairman. I have to say that Mr. Douglas, on account of indisposition, desires a delay of a few moments, and perhaps it will be well for us to start off with one or two questions from the question box.

Secretary Sessions. I have one question here in reference to the forenoon's discussion: "I wish to know if the central truth or lesson of this morning was not the individual cow, and that we must cater to her as expert dairymen?" Will Mr. Kilbourn of Lancaster answer?

Mr. Kilbourn. It seems to me that that proposition was pretty distinctly offered, and perhaps it should be accepted, with some qualifications. I think we have all had the belief that the feed should be varied for different purposes; that, for the purpose of securing a large product of butter, we should feed certain kinds of food, and for the purpose of obtaining a large product of milk we should feed certain other kinds. That was distinctly and fairly denied, and, so far as experiments show, it is proved to be untrue; and we probably have made the mistake of not properly considering the relations of the kinds of feed or the rations to be given to cattle. The experiments which have been tried with a considerable degree of care and with pretty uniform results, show that the feed which will produce a large flow of milk will also produce a large yield of butter.

Then another matter which was stated, and which was pretty well proven, and which I think more of us will be inclined to accept as we give more consideration to it, was, that it is not worth while to cook the feed, or to scald it, or to heat the water. Those three points seem to be pretty well established, and they are contrary to the former experience of a great many individuals; but an experience under different circumstances, — an experience which had to do with barns of a low temperature, and with cattle kept, perhaps, in a poor condition. My own belief is, notwithstanding the strong statements made by one gentleman here, that cows that are kept in a moderately warm barn, that are fed with substances which keep their blood warm, do not need to have the water warmed, and that it is not worth while to do it. Of course there are extreme cases. We do not want to water them with water that comes with ice all around it and over it, but to give them water to drink which is of the temperature of moderate spring water or good well water. So I think that a good many of the old-fashioned ideas of our farmers are being proved to be wrong, not only with reference to feeding dairy animals, but with reference to feeding pigs. It is pretty well established that the old theory that everything for pigs must be cooked, not only involves a loss of the fuel and time expended in the cooking, but is an absolute loss in the digestibility of the matter that is assimilated by the pigs. Under such circumstances we may well be prepared to accept some further modifications of our old ideas. That we should cater to the individual cow I think there is no question, — that we should cater to her condition and to her appetite. We find that, out of a herd of thirty, one or two will eat considerably more than the others. They have strong appetites, and some of them will readily take and consume a considerable amount of feed which perhaps has been picked over by the others; showing that those individuals have a capacity for consuming, and we will presume assimilating, a larger amount of feed than a good many others of the same herd, and under pretty nearly the same conditions. Then an individual cow differs very much as to her own condition, as to the flow of milk which she may be producing and the requirements of her system in other directions There may be a considerable economy in saving something from the rations of those animals who either will not consume it, or, if they consume it, will fail to assimilate it, and in giving it to those animals with stronger appetites and a better relish, who will not only consume more but make a better return. I think it is the experience of most of us that there is a very considerable difference between animals of the same herd, standing in the same line and under almost the same conditions in the barn. Then, again, take the conditions in a single barn; they may vary considerably by the relative positions in which the different animals stand. Some animals may stand upon the north side of the barn, and some upon the south side. Unless the barn is exceptionally warm, I think we will find better results from those animals that stand on the south side, and get the benefit of the sun's warmth and light in the winter. While I could not go so far as to say that we should cater entirely to the individual cow, I do think that a large allowance is to be made for that individuality; and, while it may not be more important than the breed or the feed, it certainly is to be considered. I think that none of our essayists would go so far as to say that the different breeds should all be kept for the same purpose; but, with the breed best adapted to the purpose that you have in view, and with careful feeding, then the next consideration, and perhaps as important as any other, is the taste, the relish and the appetite of the individual cow.

The Chairman. The lecture announced for this afternoon is on "Grading-up Dairy Stock," by F. D. Douglas of Whiting, Vt., President of the Vermont Dairymen's Association.

GRADING-UP DAIRY STOCK.

BY F. D. DOUGLAS OF WHITING, VT.

The future of American agriculture is not a pleasant subject for contemplation, especially for him who fully realizes the nature of the causes which have developed the changed conditions under which it must be pursued. An unwise governmental policy has with reckless haste opened up new lands for settlement, vastly greater in area than the necessities of the nation have required, and stimulated an agricultural vandalism, never before witnessed. Our new territory is being simply overrun, not farmed, in any enlightened sense, but robbed of its agricultural wealth, regardless of the just claims of future generations.

Westward ho! has been the cry, until the East has been drained of both men and money, required for its proper development. The market value of our farm lands has been reduced full fifty per cent, entailing a loss of untold millions, and jeopardizing those other millions of Eastern capital which have been loaned to aid in this ruinous work.

Results of Mistaken Policy.

It will be found, when the day of reckoning fully comes, that no class has been benefited by this policy excepting speculators and land-jobbers, while the farming classes, both East and West, will suffer most.

The border farmer, who is compelled to sell his corn at fifteen cents per bushel, or wheat, beef and pork at correspondingly low figures, all produced by a ruinous exhaustion of his soil and of his own vital energies, is surely deserving of our sympathies. Scarcely less so is the Eastern farmer, who is struggling to pay for his home, toiling under a heavy mortgage indebtedness, while the markets in which he must sell his wares are broken and ruined, the result of such an unstatesmanlike policy.

Protest against this Policy.

Yet, notwithstanding these deplorable results, the government seems to be committed to a gigantic scheme for irrigation, which, if consummated, will open many more millions of acres of the public domain, and put into the pockets of political vandals other millions of public treasure. I ask that you, the intelligent farmers of Massachusetts, in a mass lead in presenting an earnest protest to the powers that be, against the continuance of this mistaken policy.

The Evil a Permanent One.

The present generation cannot reasonably hope to see the vast areas already overrun, fully and properly occupied, and our markets so developed as to permanently relieve them from this ruinous pressure. A thorough development of our agriculture would more than double our present production on lands now occupied.

We may safely conclude, that these adverse conditions have come to stay. They are not, as in the past, the result of temporary causes. Henceforth, the question of success in agriculture is to be a question of "the survival of the fittest," dependent upon intellectual as well as muscular force. Old methods must "go to the wall," and there is no help for it. The best of skill, stock and appliances must be substituted for plodding stupidity, scrub stock, and the implements of a departed age.

Its Effect upon Dairy Husbandry.

Dairying has not thus far been seriously affected by Western overproduction of its legitimate products. Deception and fraud, and not the Federal government, have been chiefly responsible for the ills to which we dairymen have thus far been exposed. But there is abundant evidence that the time is near at hand when we must depend upon foreign markets, for the disposal of our surplus dairy products. We cannot then reasonably expect to receive the prevailing prices of the last twenty-five years. The key-note of all agriculturists, not excepting the dairyman, must be "cheap production and superior products." The great mass of our dairy manufactures must be improved in quality, to save the business from utter ruin.

Improvement demanded, and why.

We must improve, First, that we may increase home consumption, and build up a foreign demand. We must improve the reputation of our wares in all markets, and put our feet upon every fraud calculated to injure that reputation. Second, we must produce cheaply here in New England, that we may compete successfully with the West, and hold our own Eastern markets, and that the balance sheet may still show a profit.

How reduce the Cost of Production.

The question of cheap production obviously embraces all of the means by which dairy wares are produced. The cow, her food and care, the system of crop production employed, cost of farm, stock and appliances, all have an important bearing upon the net cost of the wares produced.

The cost of plant is an important consideration in all business enterprises, requiring a proportionately large amount of real estate, or expensive appliances, in their prosecution, and in none more so than in the dairy business at the present time. Low prices for agricultural products imply cheap lands upon which to produce them, low rates of interest on capital employed, and a correspondingly cheap outfit in every particular. Cheap, as used in this connection, has no reference to quality. The dairyman cannot afford, because of poor markets, to lower the quality of his stock; but he must secure the best, at the lowest possible cost. He cannot afford to pay fabulous prices for blooded cows, to be used for practical dairy work; yet he cannot afford, as I shall endeavor to show, to dispense with the services of the best blooded sires in breeding grade stock, even though they may cost many times the market value of bulls of common stock.

Grading-up.

With abundant capital, and proper qualifications for the business, one may profitably pay high prices for a few choice animals, with which to lay the foundation of a pure-bred herd. But it is only advisable in connection with such conditions. Dairymen with limited capital, who have good average herds of grade or native cows, can provide themselves with the best of dairy stock for practical work much more cheaply. To do this they must, like the successful breeder of blooded stock, heed those natural laws and conditions which govern reproduction. They must first determine what branch of the business they wish to pursue, and then organize success by persistent efforts on the line which they have intelligently marked out.

While ordinary improvements in dairy practice pay from the outset, the breeder must be content to wait for the growth of his stock. But the reward will be nevertheless sure, and his profits will annually increase in volume, like the increase in an arithmetical progression.

I shall treat this subject from the stand-point of a butter maker, as I propose to base my remarks upon practical facts, drawn from actual experience.

Fundamental Laws and Conditions.

No intelligent breeder, whether of blooded or grade stock, will lose sight of that fundamental, natural law, which is the basis of success in every department of stock-breeding. It is that law which governs transmission, and which is conveyed in the expression, "Like begets like."

We fail to realize the full force of this law, because of its necessarily imperfect application. It is a law of such potency that, if perfectly applied, and all the conditions of its application could remain uniformly the same through a long succession of generations, it would undoubtedly result in a perfect transmission to offspring of the characteristics of the parents.

While in many departments of stock-breeding this power of transmission has been carried to a high degree of perfection, yet in no department has it become as marked as it would have done under more perfect conditions. Perfection in this must be the work of time; and the business life of any one man is too short, however perfect his practice, to attain it, while any change, as from father to son, is morally sure to result in a change in essential conditions. This power of transmission will become a fixed characteristic of a family or race, just in proportion to the skill of its breeders, time employed, and the quality of the stock used in the outset.

Pedigrees.

A pedigree, of whatever length, is of value only as it conveys a correct knowledge of the character of the breeding of the stock described, and gives assurance that its progenitors, for many generations, were of the same type. A mere genealogical pedigree is of no value whatever, — one which recounts the names only of ancestry. All animals, however ill-bred, have unrecorded pedigrees, extending back to their original progenitors, though no one can give a diagram of them, and it would be of no value if we could. It is that mistaken idea, that long pedigrees ensure perfection, which has led to so many disappointments in the purchase of blooded stock. This early false impression has cost me hundreds of dollars. I have owned stock with long pedigrees, which, from inbred defects, was utterly worthless for dairy purposes.

It is of the utmost importance that the breeder of grade stock should use none but well-bred sires; those of "strong blood," as it is often expressed, those which have not only the external marks of perfection, but the habit also of transmitting them. He must never be tempted to use a grade sire, however perfect he may be in external appearance.

Practical Effect of Chance-Breeding.

While the proper observance of fundamental laws and conditions inevitably leads to fixed characteristics in the animals bred, the violation of them leads to opposite results. While "like" here "begets like," we must often look back through several generations for the prototype of offspring. In chance-breeding we may find every type of characteristics peculiar to the race represented in the progenitors, at no very remote distance from the offspring. As given characteristics, either good or bad, may remain dormant through several successive generations, and then re-appear, it is obvious that no reliance can be placed upon chance-bred stock, where sire and dam are both thus bred. There is obviously no fixed character established by such breeding.

Anomalous as it may seem, this want of fixed character is a great advantage in the grading-up of dairy stock. A well-bred sire, with strong powers of transmission, when coupled with dams thus irregularly bred, will transmit his own qualities to a much larger proportion of his progeny than when coupled with pure-bred females of opposite characteristics.

By such a cross with well-bred Jersey sires, I can build up a butter-producing herd of the Jersey type much more readily than by a cross with full-blooded Holsteins or beef-producing Herefords. And, also, when the Holstein type is desired, Holstein sires would beget that type much more readily by a cross with native stock, than with Jerseys or Devons. With the latter, the fixed habit of transmission must be broken down; while with common stock there is no such fixed habit to be overcome, and hence the sire gives his own impress to a much larger proportion of his progeny.

Selection.

But not to all; and here comes in the next essential condition of success, and it will apply to all herds, whether blooded or grade. Judicious selection is next in importance to skillful breeding. A rigid test must be applied to every individual. There are certain external characteristics which may guide us in the selection of dairy stock, but these cannot, for various causes, always be relied upon. Where the more important of these are wanting, we may safely conclude that the animal is worthless for dairy purposes, and dispose of her while young.

External Indications of Good Dairy Stock.

Some of the external indications of a good butter-producing cow, are: —

1. A large, evenly balanced udder, extending well forward and backward.
2. Medium-sized teats, not set too closely together, yielding their milk easily, and in large, smooth streams.
3. A broad posterior, with body tapering towards the head, giving ample room for a broad escutcheon, and development of udder, with loose folds of skin in rear of udder, in heifers and cows not in full flow of milk.
4. A good development of the digestive organs.
5. A large, crooked, well-developed milk vein.
6. A thin, pliable, yellow skin, with its accompaniment of a fine, soft coat.
7. A nervous but docile temperament, gentle when well treated, but intelligent enough to resist abuse.
8. Small, delicately formed head and horns, with none of that coarse, ox-like appearance, peculiar to ill-bred stock.

Correct Ideals of Perfection.

These are all indications of good butter-producing cows, yet, when judged by the beef producers' standard, such animals may be regarded as homely in the extreme. The butter maker must form his ideals of perfection by those traits which he learns, from experience, point to the best pecuniary returns from his dairy, and not from a beef standard. He will often find it necessary to dispose of his favorite cows, when judged by this standard. Of those which give the largest flow of milk, and will command the highest prices when wanted for family use or for the production of milk for the milk trade, hence they pay him well for the raising. Absolute, arbitrary tests, without favoritism, must determine his action, if he would quickly bring his herd up to a productive capacity of three hundred pounds or more per annum.

Manner of Selection.

In small dairies the churn should determine individual merit. Not by one or two trials, but by a series of trials extending through a good portion of the year. Please remember that it is the "lasters" in the herd, and not the spasmodic milkers, that must be relied upon for large annual yields. Many cows will do well for the first three or four months, when their flow will diminish, and at the end of eight or nine months they will dry up, even with the best of food and care. Such cows must be dismissed from the herd, however pleasing to the eye in external appearance.

In large dairies some less laborious means may be adopted, which will give nearly as satisfactory results as the churn test. With a thorough knowledge of the structure and characteristics of milk, and with proper appliances, we may learn to judge of its quality by the phenomena which it presents when submitted to certain conditions.

My own Method.

I hold in my hand a very simple device, which I had constructed in 1867, with three others, of different depths, for the purpose of determining the practicability of the deep setting of milk for cream-raising purposes.

In one, the milk was set three inches in depth; in another, six inches; in this, twelve inches; and in still another, eighteen inches. I had, as you see, a glass placed in the side, with a per cent scale attached, that I might note the changes which took place within. I soon found that I had in this device an excellent means for determining the comparative value of the milk of different cows for butter-making purposes; and I had two dozen of them constructed for that purpose. This was the origin of testing tubes. I make this assertion, not only from my own personal knowledge of the matter, but also upon the testimony of the late X. A. Willard, who was a standard authority in such matters.

By the use of this simple device, and the microscope, I learned more of milk and its peculiarities, in a few months, than I could in a life-time of experience and observation, without it. I fixed upon thirteen inches for the depth of my testing tubes, because I desired to have them correspond with the depth of the pails in which I set the mass of my milk.

How used.

The manner of using these cans, and determining results, is very simple. Each can is filled with the milk of an individual cow, immediately after being drawn, and placed in tanks of water at a temperature of sixty-three degrees. All are submitted to precisely the same conditions, and a record taken at six, twelve, twenty-four and thirty-six hours from the time of milking. In this manner I learned many interesting practical facts. Among these were: —

1. That the milk of each individual cow has its own peculiar time for sending up its cream.

2. That this time is dependent upon the characteristics of the milk, and its butter globule.

3. That, knowing these characteristics of the different samples, we may readily determine their comparative value for butter-making purposes.

Tell me the time required for a given sample of milk to send up its cream through a depth of twelve inches, at a temperature of sixty-three to sixty-five degrees, and I will tell you its quality for butter-making purposes. Tell me also with regard to the annual milk production of the cow furnishing such sample, and I will tell you her standing as a butter producer.

The first tests of my herd gave some surprising results. While the milk of one cow parted with its entire cream (thirty per cent) in three hours, that of another, standing by its side, continued to rise for thirty-six hours, while I had reason to believe that much of it never came to the surface.

These novel and unexpected results of course excited my curiosity, and led me to study the phenomena presented in the manipulation of milk. Further investigation revealed the causes of this wide difference in results. They were easily traced to the difference in the peculiar qualities of the two samples.

The first was found to have a large uniform butter globule, to contain comparatively little caseine and other milk solids. The milk when skimmed had a thin, blue, watery appearance. These structural facts pointed conclusively to the causes for such a rapid separation of the cream.

It was found, also, that this milk, as might well be supposed, possessed poor keeping qualities, and would not bear transportation. It matured quickly, and decayed quickly. Its cream was solid, of a rich golden color, churned quickly, and it took but a small amount of it for a pound of butter. Milk presenting such phenomena is my ideal of perfection for butter-making purposes, and experience has taught me to rely upon these phenomena in the selection of my cows.

The characteristics of sample number two were precisely opposite. The butter globule was very small ; cream, white and poor, and required a long time in churning. The butter manufactured from it was white and lard-like in appearance, contained more caseine, and had poor keeping qualities ; while the milk had good keeping qualities, and would bear transportation well. The skimmed milk appeared to be a nearly solid mass of caseine and other milk solids. This latter fact, taken in connection with its diminutive butter globule, was to me a sufficient reason for the slow and imperfect separation of its cream. The cow which produced the latter sample gave much the largest flow, and I had regarded her as one of the best cows in my herd.

I have purposely given extreme cases, yet not greater than I have repeatedly found in my twenty-two years' experience since that time. Nothing approaching these extremes can now be found among the young stock of my herd.

Development of Dairy Stock.

There is one consideration which is too often overlooked by dairymen, and that is, the matter of development of young dairy stock. Breeders of trotting horses well understand that success with them depends very much upon the early development of their colts. But how many dairymen are aware of the fact that a proper development of young stock is quite as essential to success in the dairy as in the stud?

Heifers with good natural butter-producing qualities, judiciously reared from the outset, and when in milk fed liberally on well-balanced rations, properly milked and cared for in all respects, will often give milk through the entire year when in calf annually, and at maturity reach a productive capacity of three hundred pounds or more of butter per annum. In dairies thus bred and developed, one of the most important duties of the herdsman is to attend to the matter of drying off such heifers at least a month before they are due to come in; otherwise their vital energies are overtaxed, and they may thus be permanently injured.

The same animals, submitted to the treatment bestowed upon young dairy stock upon many of the dairy farms of New England, would go dry three months of the year and would not reach a productive capacity of over two hundred pounds per annum.

The wide difference in the productive capacity of herds often results, in my opinion, as much from difference in early development and care, as from any inherent difference in the stock itself. Dairymen who have neglected this proper early development in their herds, cannot reasonably hope, by spasmodic effort, to raise their standard of production to a high point. Development, whether in man or brute, is the work of time and favoring conditions, and can only be accomplished in accordance with nature's laws.

Difference in Cost of Keeping.

It is often argued that it costs much more to keep a herd of cows producing three hundred pounds of butter per annum than one producing one-third that amount. While practically it usually does costs more, yet this is not necessarily the case. The difference in amount of butter product may result from a difference in adaptation alone.

The cows in my own herd, of which I have spoken, giving but six per cent of cream, I have reason to believe would not yield one hundred pounds per annum by any ordinary process of cream raising, while those giving thirty per cent would yield more than three hundred pounds; yet they stood side by side in the stable, and were fed and cared for the same.

Cost of Butter Production.

I have said that henceforth the key-note of New England agriculture must be "cheap production, and superior quality." Have you ever computed the difference in the cost of butter production, under favorable and unfavorable conditions, and fully realized the magnitude of the rewards of dairy improvement? Let us apply the figures to this problem.

I will assume that the net cost of labor and keeping of a dairy cow, after making due allowance for the value of the skimmed milk, buttermilk, and fertilizing material, retained upon the farm, is forty dollars per annum. With these conditions, the cost of production per pound of butter will be as follows: With a herd so well bred and developed that it will produce an average of three hundred pounds per cow, per annum, the cost will be thirteen and one-third cents per pound. With a yield of two hundred pounds, it will cost twenty cents per pound; and of but one hundred pounds, it will cost forty cents per pound. When the market value of butter is but twenty cents per pound, as with most summer dairies, the former would receive a profit of six and two-thirds cents per pound, which would afford a profit of twenty dollars per cow, and of four hundred dollars on a herd of twenty cows. The second would realize no profit, though, in common with the rest, he would have the benefit of a cash home market for the food consumed. The third would lose twenty cents on every pound manufactured; an average of twenty dollars per annum on each cow kept, and four hundred dollars on a herd of twenty cows. This represents a difference of eight hundred dollars in the annual financial results of these two extremes in dairy practice, and of sixteen thousand dollars in twenty years of such practice.

Let us approach this subject from another stand-point, and apply it to winter dairying. We will assume, as before, that the net cost of labor and keeping is forty dollars per cow; the average annual butter product, three hundred pounds; the market value, twenty-five cents per pound,— not a high average price for winter dairies. On this basis, the gross receipts would be seventy-five dollars per cow.

If we deduct from this the cost of labor and keeping, we have a balance of thirty-five dollars, which will represent the net profit per cow; a sum equivalent to seven hundred dollars per annum on a herd of twenty cows, and of fourteen thousand dollars for twenty years.

With an average annual product of one hundred and fifty pounds, which is much above the average of the dairies of the country, the gross receipts will be but thirty-seven dollars and fifty cents per cow. Deduct this from the cost of food and labor, and we find a loss of two dollars and fifty cents per cow, and of fifty dollars on a herd of twenty cows; making a difference of seven hundred and fifty dollars in the annual financial results of the two kinds of dairy practice, and of fifteen thousand dollars when continued for a term of twenty years.

Mr. Chairman and gentlemen, I will only ask, in closing, *Will it pay to improve our dairy stock?*

The Chairman. Have gentlemen any questions to ask on this most important subject of raising dairy stock? There are a large number present who are engaged in this industry, some from neighboring towns. I know there must be questions revolving in your minds which you would like to ask the lecturer, and now you have an opportunity to do so.

Mr. Allen. I have noticed the same thing that the speaker has mentioned; that the cream from the milk of some cows will rise in an hour or two, while in other cases it will take thirty-six hours. I did not quite understand whether he said the butter which came from the cream that rose quickly had or had not the keeping qualities of that made from the cream which came up slowly.

Mr. Douglas. The butter kept well, but the milk had poor keeping qualities.

Mr. Allen. But still you would say that the former is the much better class of cows to keep?

Mr. Douglas. Yes, sir; for the largest production of butter. In the case stated, they were really unfit for anything else.

Mr. Allen. As a general proposition, you would say that the cow whose cream came up quickest was the best for butter purposes?

Mr. Douglas. Yes, sir.

Mr. Dyer. I would like to ask what breed the gentleman would recommend to grade-up our stock with.

Mr. Douglas. For a butter maker, I would recommend the Jersey and Guernsey. If my object was milk production, of course I should recommend the Holstein or some breed of a larger growth.

Mr. Bradley. The speaker has only spoken upon one side of the question; that is, the butter side. There are two sides to this question, — the milk side and the butter side.

Secretary Sessions. I think the essayist remarked that the same principles would prove correct in grading-up a herd of Holsteins or any herd of a milk-producing type.

Mr. Douglas. Yes, that is what I meant to be understood, although I have no personal experience of that kind. In fact, reason and observation teach me that that is so. You can get the same improvements in that direction by the use of Holsteins or of some type which gives a large flow. I would make that distinction. For butter-making purposes I would select sires from races which are best adapted to butter making; for milk production I would use a sire adapted to that branch. Bear in mind that there is room for all. There are two distinct classes of milk, each adapted to a particular purpose. The milk which I describe for butter-making purposes is not adapted to the milk trade. The housewife who receives such milk in the morning for family use will have at tea time a mass of cream and blue skim-milk. She does not want that type. But there is milk which is much better adapted to cheese and to the milk trade than this, which is especially adapted to butter making. I gave extremes, and I gave one extreme which I would not recommend, although some milkmen might; to wit, the kind that gave only six per cent of cream. I should not want to sell that milk to customers; it is too poor. I gave extremes purposely, and between the two extremes you will find all grades and qualities.

Mr. Goddard of Greenfield. I think it will be conceded that the largest records that have been made of butter-making and milk-producing cows have been made by purebreds; and, with the present prices for which Jerseys or almost any pure-bred stock can be bought, why should the farmer use grade stock? I certainly can see no reason for it. I think if a man has pure-bred stock he is more apt to take better care of it than of grade stock; and as long as upon the character of the stock depends to a large extent the profits, I believe it better for the farmer to have pure-bred stock; and besides, if he has any to sell, it will usually sell for better prices. My belief is that no farmer should be without pure-bred stock. Of course I would not advise a man to go into it in a large way at first, but you can start in a small way, and by and by you will find that you have increased the quality of your herd at small expense.

Mr. Douglas. I have bred-up native stock that will outstrip anything that I have bought as full-blooded from the best herds. It is an actual fact that by so doing I have bred my herd up to three hundred pounds very much quicker than I could by any purchases that I could make of pure-bred stock. We all understand that a breeder is not going to sell his best stock; we have got to take second-class stock. I started off with the idea of buying blooded stock for the basis of my herd, but I found that my graded-up stock outstripped the blooded stock in actual working value.

Mr. Lyman. I am very thankful for the statement that the essayist has just made. I have made that statement from practical tests, but I have never found stockmen or any others who seemed to credit it. I have bred-up graded stock that, as the gentleman has said, outstripped any pure-breds I have ever had or my neighbors have had.

Mr. Dyer. I would like to ask why. The facts are given us; is there any reason why?

Mr. Douglas. Well, I indirectly pointed to the fact that blooded stock for butter-making purposes or any purpose is not all bred perfectly. If for the past thousand years it had all been bred perfectly, we might buy blooded stock and be sure of getting the very best; but, as a practical fact, there is but a small percentage of blooded stock that will come up to three hundred pounds or three hundred and fifty pounds of butter. That is the actual fact, as I found out. I have been obliged to sell fine-looking cows, that had all the appearance of being good animals. Only last year I sold a cow that had every mark of being a superior animal, but she was worthless; she dried off early; she did not hold her milk. I said to myself, "You can cheat somebody on that cow tremendously," but I did not want to do it; I would not ask any high price for her; and many times I have been compelled to sell nice-looking, full-blooded stock because of their defects. In one instance I remember I bought some calves from one of the best herds in Vermont, a herd that had a high reputation and had taken a great many premiums. I bought them when they were less than a year old, hoping to get ahead of the breeders in that way, for I knew they would keep them if they found they were superior animals. I took them home, and soon ascertained that they were very nervous creatures. If a stranger came into the herd, up their tails would go and away they would run. Every cow I have is as gentle as a lamb, but these calves were nervous, had small bags and long legs. A man who has had a great deal of stock from Connecticut for several years came to me and said, "Can't you sell me some blooded stock?" "Yes," said I, "I will sell you blooded stock; I will sell you the pedigrees and give you the assurance that two of them are the meanest animals I ever bred. Still, the pedigrees are all right." I had found that the breeder had made a mistake in his breeding, and he had unloaded on me. So I say, if you can be sure of getting first-class blooded stock, go and buy it. You see I lay great stress on this point of getting the best class of pure-bred stock. I suppose that you here are mostly men of wealth, and can do that, but a common farmer cannot do it. It was so in my own case; I had my own capital to make, I had to begin and feel my way up. And my own experience has taught me that very much can be done by the common farmer in the way of breeding-up a herd, by pursuing the course I have indicated, for much less money than by purchasing blooded stock. If he finds blooded stock that are satisfactory, let him keep them by all means, but never keep them because of their pedigree.

Mr. Dyer. Which helped you most in breeding-up to three hundred pounds, your native stock or the full-blooded sire?

Mr. DOUGLAS. Well, both. They must go together. It is wonderful what strides we can make with good, strong, rugged, common stock, with a pure-bred male; but they must go together, if you would succeed. No one can breed perfectly. Some animals will crop out that he cannot afford to keep. It is those animals that we fellows buy, generally.

Mr. HICKOX. It seems to me we are coming onto very delicate ground here, but I hope we shall learn what will be of value to us. I began with breeding grade Jerseys, because I was breeding for a purpose; and of course I had heard this and that farmer say, as every man has, — as I have heard them say here to-day, — that he would rather have a grade cow than a pure-bred. I thought perhaps there was something in all that. But I found pretty soon that the grade cow that my friends talked about was not as reliable as a pure-bred animal was. You cannot take a full-blooded sire and a female from common stock and make a perfect animal. You want, in order to make a cow that will give a great record, both the male and female bred excellently, and through long generations. This gentleman says that he has had cows in his herd that were well-bred, that looked like fine animals, and yet they were poor stock. Now, how has this come about? The Jersey cow has done a great deal for us in the State and country. There have been these pedigrees attached to them, and the result has been that it has been *pedigree*, and nothing but *pedigree*. Now, the pedigree does not amount to anything, of itself; but if you have a good animal first and then a good pedigree, and if you breed those carefully and judiciously, you will have results that will beat a grade cow every time. But if you have got a Jersey sire and I have got a dam, and we throw them together regardless of their characteristics, you will have inferior animals; you will perhaps have a fine pedigree, but not a fine animal; it will very likely be inferior to some grade animals. I do not believe that a grade cow is better than a pure-bred; it is not according to my experience. If we cannot have pure-bred herds, let us have the best we can get. I say, go to work and breed the very best animals you can. It is a noble work. It requires care, thought and study, but there is a great deal of satisfaction in it.

Mr. Douglas. I heartily endorse all that the gentleman has said. You will observe that my theory and practice are based on that very idea of having pure-bred animals as sires. We must have those in order to obtain perfectly bred herds. But it has been admitted that but a small proportion of those are what we want. A large proportion must be eliminated from the herd; and, with these thousands of farmers in New England who must set up this work immediately, where are the blooded cows coming from? But I say, to every man who has means, lay the foundation for a blooded herd.

Now, what are the facts? To my personal knowledge there are many herds in Vermont that have been bred in the way I recommend up to 300 pounds and over. I have the facts with regard to individual grade cows and their production. I have one here that gives 503 pounds of butter; another, 480; another, 461; another, 410; another, 504; another, 633 pounds. Now, these are facts that we cannot get by; and, while I would heartily indorse what the gentleman has said, if it were possible to have this pure-bred excellence which I have dwelt upon, these facts show what can be done with grade animals. I am talking to a great many farmers who must set about this work, and time is a matter that we must consider. I would advise every such farmer to procure a pure-bred animal to lay the foundation for his herd; and if the farmers of New England would realize the importance of this, it would give the blooded herds of New England a boom such as has never been known heretofore. Every blooded animal of the right sort would be needed for this purpose. I am not saying one word against full-blooded herds, but I am emphasizing the fact that we must have them. It is one of the fundamental conditions of success in breeding-up a grade herd.

Mr. Goddard. The gentleman said that common farmers cannot afford to buy pure-bred stock at the high prices that are asked for such animals. I do not agree with him in that. I started a few years ago without any money, and I can say to-day that I have got a herd of pure-bred stock. The reason why we have so many poor farmers is because they will not buy good stock. If they would procure good animals in the first place, and breed from those, there would not be so many poor farmers to-day in the country. These good animals are just the ones that we poor farmers should buy.

Mr. Fitch. This talk has all turned upon butter for the last fifteen minutes. I would like to ask the gentleman this question. Suppose you had two kinds of milk, one of them having eight per cent of cream and the other having sixteen per cent of cream, which of those two kinds of milk would you take if you were going to raise calves, or for use on your table?

Mr. Douglas. As a practical fact, the butter element of milk will kill calves. You have got to take out a part of that butter element to have calves thrive upon it. I would have a medium amount of caseine and solids as compared with butter. I have cows whose milk I would not give to young calves; I would not even let their own calves drink it; it would soon kill them.

Mr. J. T. Everett of Princeton. I have raised two or three times within twenty years calves that came from cows which were excellent animals both for butter and milk, but the calves made worthless cows. What is the solution of that problem? From the nature of all animals, the human animal as well as others, we suppose that traits are developed in the children which the parents had. Now, I solved it in the last case to which I referred, by supposing that, although the cow was good, the bull was worthless. I think that was the case in the other instances where I tried to breed a superior butter or milch cow from a very excellent mother, and the animal proved to be worthless. How much does the essayist depend upon that factor for grading-up animals?

Mr. Douglas. I thought I brought that out with sufficient definiteness, when I said that good and bad qualities will remain dormant, and then crop out after several generations. There is a point which it is easy to test when it is necessary. Have no favoritism about it. Most farmers who have calves from superior cows keep them because the mothers are so good. Never do that. The animal that I spoke of that came to the Boston market was a fine-looking, full-blooded animal. She came from a cow that was a fine animal, that gave an excellent record of milk and butter; but that cow proved worthless. The bad qualities remained dormant through some generations, and then cropped out. That is a point we must look at. We should never keep an animal because its mother was a good one, but let it stand on its own merits.

Mr. EVERETT. They are just as likely to be carried down from one generation to another on the part of the bull as on the part of the mother.

Mr. DOUGLAS. Certainly.

Mr. FITCH. If a man wishes to raise a good calf from a good cow, does he not often milk the mother a great deal too long to do it?

Mr. DOUGLAS. I have heard good breeders say that the progeny of a cow might be better than the mother herself, because the mother has been overtaxed through long-continued milking. That is the theory; I do not know whether it is so, or not. As was said this morning, there are a good many conditions which we have to consider in all these things.

QUESTION. I would like to ask about the matter of breeding young animals. At what age should they come in?

Mr. DOUGLAS. I like to have them come in at two or two and one-half years old. I want to get a good physical development. I do not want to feed them on too rich food, and let them get fat. Then, after they come in, I do not give them corn meal or concentrated food, but rations that are calculated to develop the milk organs. Then, with careful milking and care, you develop the animal properly. *Care every time!* Never allow it to stand out in the cold. All those things must be taken into account. Take the best care possible without overdoing it, without feeding too rich food, but endeavor to develop the milk-producing qualities, etc. Some people are careless about drying off heifers. They do not give much milk, and they think it is not of much importance. I hold that it is very important to keep up the flow of milk at the outset, — eleven months, if you can, the first season. The next year you will find it easier to keep that flow up. Be careful about giving a calf rich food, like corn meal or cotton-seed meal; give it something that will develop muscle, not fat. I do not believe in giving much linseed meal. When a cow comes in milk, then give concentrated food in connection with the other food; not cotton-seed meal alone, but always in connection with other food.

Question. How about oatmeal?

Mr. Douglas. That is excellent. I usually raise a large quantity of oats. I once sold my oats because they brought so much higher price in proportion to their feeding value, and bought cotton-seed meal to take the place of the oats. I mix peas with the oats. I find that oats are excellent to make up a good milk-producing ration. So of late I use my oats for feed, instead of exchanging them for cotton-seed meal.

Mr. Bradley. I hardly agree with the speaker in regard to breeding grade stock. I think that pure-bred stock is better, but farmers will not buy pure-bred stock. But they can all get a pure-bred male, and that is a stepping-stone to something higher. Farmers demand cheap stock, and breeders are raising stock to supply that demand. If they bred high-priced stock they could hardly sell it, but cheap animals will sell readily. Farmers are to blame in this matter. They should not only buy the best, but, when they pay high prices, they should know they are getting the best. Pure-bred stock is bred for speculative purposes, and breeders find that they can make more money out of cheap stock than they can out of high-priced stock. An animal that has a long pedigree is not necessarily the best. That pedigree may be made up of animals with a great variety of qualities as respects the production of butter and milk, and of animals of all shapes and sizes. The animal needed is one that has been bred in one continued line for generations, each ancestor having those peculiar qualities which we wish to breed and perpetuate in our herds.

Mr. Fitch. Does not the character of the animal depend more on the character of the feeding the first two years, other things being equal, than on the pedigree?

Mr. Douglas. I thought I brought that out with sufficient clearness. I said in my opinion feeding had quite as much to do with success as the inherent characteristics of the animal. With regard to this other point, I want to emphasize and re-emphasize it. I do not want any man to go out of this hall carrying the impression with him that I am in favor of using grade males on any condition. I say that no farmer can afford to use a graded sire, no matter how good his external appearance may be. In my younger days, being short of capital, if I had a grade male from an excellent cow I was foolish enough sometimes to use it. That is why I have been twenty years in getting my herd of forty cows up to three hundred pounds of butter a year. If I had known at the beginning what I know now, it would have been worth more than a thousand dollars to me.

Professor Cooke. There is one point in the essay this afternoon that I wish to speak of, and that is, the choice of the speaker in regard to the large or small globules. He says that if he has two milks, one containing large globules and the other containing small globules, he would take the milk containing the large globules, because that would produce the best butter. That is undoubtedly the doctrine held by a good many first-class breeders, but that doctrine has received some very severe blows in the last two years. You all know that the Holstein breed has a butter globule that is very small, — it would be difficult to find any Jerseys that have butter globules so small as the average Holstein; and yet within the past three years the Holstein has taken the first prize away from the Jersey at quite a large number of the competitive butter exhibits where the butter products of the two breeds have come together, showing that the mere size of the globules is only one of the factors, and that it is possible to make first-class butter out of cream in which the globules are very small.

There is one other point in regard to which I might repeat the words of the speaker. He says that when I spoke of not warming water for stock, it was like holding out a red rag to him. I might reply that when he speaks of using the depth of cream as the measure of the butter value of milk, it is the same sort of challenge to me. We have done an immense amount of testing on that one point — whether the depth of cream in the gauge is a correct criterion of the butter value of the milk. As I told you this morning, we have a herd made up for experimental purposes, and we have animals in that herd which, with the same amount of butter fat in the milk, will show forty per cent difference in the amount of cream. That is, the body of cream which from one animal would make one hundred pounds of butter, from another animal would make one hundred and forty pounds, there being a difference of almost one-half in the butter derived from the cream. Now, that was not cream under different conditions, but it was cream from the same milking, set side by side in the same room, and under absolutely the same conditions. They were both put into cold water, and, although not submerged, yet the water covered them so that the temperature of the air around them was exactly the same. They were raised under exactly the same conditions, yet we have found that wide variation when we have tested them over and over again. And moreover, so different is the character of the cream from different cows and from different dairies, that taking the milk and putting it into a centrifugal machine and whirling it for sixty thousand revolutions will not compact the cream so that it will be of equal value. There is no way of manipulating cream by which you can make equal bulks of it produce the same amount of butter. That point is perfectly clear. But when you come to the other point, whether churning cream will afford a proper test of the butter value of a cow, there is more chance for deception. I believe that the churn test, setting the milk by itself, skimming the cream, and churning it and weighing the butter, is not a correct way of estimating the butter value of the milk of a cow. That may seem a pretty bold statement, and if you are going to set the milk of that cow by itself every time, I shall have to take it back. If each time the milk of the cow is to be set by itself and the cream churned by itself, then the butter is the only accurate test of that cow; but as soon as you take the milk from that cow and put it with the milk from other cows, you so change the way that it handles, you so change the raising of the cream, and you so change the character of the churning of that cream, that you cannot judge from what that milk has done by itself what it is going to do when mixed with other milk; and so, after all our tests of all the different systems that we can get, we are compelled to fall back upon the measure of the actual butter fat that there is in the milk.

Mr. Douglas. Somebody spoke about the experiment stations. I tell you the experiment stations cannot get along without us practical farmers any better than we can without them. Now, unfortunately, when you come to the tests at the experiment stations between warm setting and cold, the fact is, that in a number of tests the conditions with warm setting were in no one instance such as made such test possible. This was the case in a test made at one experiment station and seconded by another, which tests were published in the report of our Vermont Dairy Association.

There are a number of facts that come right in there. You look at the cream raised on one can of milk, and you can see that it is very rich, very solid, and usually yellow. I grade my cream into three different grades of color, — first, second and third. The first grade is not always, but usually, high colored; it is almost butter; you can almost see the butter globules; it separates easily; while the other cream is white. But I cannot follow up that point. The other point is this. I would like to ask the professor if he knows that in those cases where the Holsteins have made those wonderful butter records the globules were so small? I wish the professor would answer that question, for I think I have got him right there.

Professor Cooke. That is the fact, that the butter globules were small.

Mr. Douglas. Well, so extremely small as I spoke of?

Professor Cooke. Yes, what you call small globules; a good deal smaller than any your Jerseys would give.

Mr. Bass. I think Mr. Douglas did not make clear what he meant, when he said that the conditions with warm setting were not such as made it possible to have a test. It seems that there is a certain temperature which is so unfavorable for cream raising that it needs further explanation. Professor Robinson, at the meeting of the New York Dairymen's Association last year, stated that there was an unfavorable temperature for raising cream ; that from fifty-five or fifty-eight to sixty degrees seems to be especially unfavorable ; while a lower range, among the forties, and again as high as sixty-three or sixty-five, is favorable.

Mr. Douglas. I thank Mr. Bass for calling my attention to that. There is a point between cold setting and warm setting where you cannot make cream raising a success ; that is, from fifty-eight to sixty degrees, and less. Farmers have been led to experiment for themselves, and have been awfully taken in by attempting to raise their cream at that temperature. If you heat ordinary Ayrshire, Durham or Holstein milk to sixty degrees, you must not expect success ; but if you go up two or four degrees then you have success. I am not theorizing about this, it is something I have practiced for the last twenty years ; and I know that if you will set your milk at from sixty-three to sixty-five degrees, you will get a more perfect separation than at any other temperature. You will get much less bulk of cream. It takes about thirty-three or thirty-four pounds of warm set cream to make a pound of butter, while by cold setting it takes one-sixth more. That is a point which I thank Mr. Bass for calling my attention to.

Mr. Hurley. I would like to ask the speaker if he would inbreed, and if so, to what extent?

Mr. Douglas. Occasionally, but in ordinary practice I do not. The danger is, that you are liable to reduce the vigor by inbreeding. I know some of the best breeders do it. They do it in breeding sheep, but I would not follow it to any great extent.

Question. How long would it be necessary to keep the temperature at sixty-five degrees?

Mr. Douglas. About thirty-six hours.

Question. Do you have to use artificial heat during that whole time?

Mr. Douglas. In the winter the milk room should be kept at about the same temperature that you want the milk ; but in the summer it will require a very little ice. The room should be constructed with non-conducting walls, and you can raise the windows in the evening, which will carry the room down to the night temperature; and in that way you obtain the necessary conditions with very little ice. The true point is sixty-three or sixty-four degrees, to get the most perfect production.

The Chairman. I see that Mr. Williams of Walpole is present. I will ask him if he has had experience which will bear upon this question.

Mr. Williams. I am very glad to be recognized here as a farmer. I have the honor and the pleasure of running a pure-bred Jersey herd, and so far I like it. I believe, as my friend Mr. Douglas has said, that, if he had started a pure-bred herd as intelligently as he has his grade herd, he would have reached an average of three hundred pounds of butter from each cow in less than twenty years. It has been my fortune, with one-third of them two-year old heifers, to go considerably beyond that. Now, there is a single point in all that has been offered here that I think needs large consideration, and that is, the uniformity of the quality of your milk and your cream. Every speaker who has touched upon the subject has stated that cream of different characters takes different lengths of time to rise, and it has also been intimated that it takes more time to churn one kind of cream than another. We see, therefore, that that is an important point; and that it is very desirable, and almost necessary, if you are to get the full value of your product, — if you are to get all the cream from your milk and all the butter from your cream, — that that milk and cream should be as uniform as possible; and that with cream from pure-bred stock, whether it be Guernsey or Jersey or Holstein or Ayrshire or Durham, you are more likely to get all of the cream and all the butter from the cream if you have uniformity in your cream, which you cannot possibly get with a graded herd.

The Chairman. I would like to ask if Mr. W. A. Kilbourn can give us any information upon this important subject.

Mr. Kilbourn. I do not think that I can give much information upon this subject. We keep some grade cows for a special purpose, but our herd is largely pure-bred Jerseys; and, while we set the milk for different purposes, partly for cream and partly for butter-making, I cannot give such an accurate statement of results as I should like to be able to do.

The CHAIRMAN. If there is nothing further in the way of questions or discussion on this important subject, the question box will be opened. Our Secretary will read the questions.

Secretary SESSIONS. Here is a very practical question to all stock growers: "How shall we cleanse a stable of cattle lice?" Will Dr. Lynde tell us something about that?

Dr. LYNDE. About the best thing you can do is to fumigate with sulphur. Remove the cattle, close the stable as tightly as you can, put a liberal quantity of sulphur into a kettle, pour alcohol upon the sulphur, light it, and let the fumes go through the stable, and they will kill every living thing.

QUESTION. Would not coals of fire under the sulphur be as good as the alcohol?

Dr. LYNDE. No, sir; alcohol is better.

QUESTION. How would you deodorize your stable so that the fumes of the sulphur would not affect the milk?

Dr. LYNDE. Open it freely to the air, and in a short time the fumes of the sulphur are gone. Is not that so, Dr. Goessmann?

Dr. GOESSMANN. That is so.

Mr. DYER. In my own experience I have found that a mixture of equal parts of lard and kerosene, which is perfectly harmless, is very effectual, if the dose is repeated once or twice. One application kills the lice, but not the nits, so that it is necessary to repeat the dose.

Secretary SESSIONS. The next season your creatures will be covered again, if the stable is not freed from the lice.

Dr. LYNDE. The effect of that is limited to the lice on the stock. The lice and the nits are all about in the stable, and you must get rid of them as well as those on the stock. The remedy which the gentleman suggests will not do it effectually. There is another remedy, and that is a solution of corrosive sublimate. It is a deadly poison, which will kill the lice and kill the nits, and, if you put it on too freely, it will kill the cattle.

Dr. GOESSMANN. Carbolic acid and lime is also an excellent remedy for lice in a stable.

Secretary Sessions. How would you use the carbolic acid and lime?

Dr. Goessmann. About an ounce of carbolic acid to a pound of slacked lime.

Question. I would like to inquire, if the stock are rid of lice in the spring, if the lice will stay in the stable and live through the summer when the cattle are turned out to pasture?

Secretary Sessions. I can answer that they will. I know it by experience.

Mr. Bradley. To kill lice on cattle I would recommend common insect powder. You can put that on where you could not use lard and kerosene. Take a pepper-box, and you can go over an animal in a quarter of a minute, and in a very short time go over a whole herd. I will guarantee that the lice will all be killed with three or four applications. If you sprinkle it around the horns, around the neck and over the back several times, you will kill them all.

Mr. Fiske. My cattle used to be badly troubled with lice every year, but for the last eight or ten years I have adopted a very simple means of ridding the cattle of lice. I keep a pail of flour of sulphur in the barn, and when a creature shows symptoms of having lice by lapping and rubbing, I take a little hand sieve and sift a small portion of that sulphur over their backs and heads, and the remedy has been effectual. My stable used to be full of them, and when the cattle came into winter quarters they would soon be covered with lice. I used to put on soap-suds, tobacco, and other things; but I never found anything so simple or so sure as this practice of sifting a little flour of sulphur over their backs. I have applied it two or three times, once a week, and it is very seldom now that I have occasion to use it at all.

Mr. Marshall. I cart into the stable a portion of dry lime, and every time I clean out my stable I put it down where my cattle lie. It fills their hair with dust, and keeps the lice off of my cattle the best of anything I have tried. I have tried all the remedies I have heard spoken of, and there is nothing so effectual and so safe to use as that.

Secretary Sessions. I suppose you are all aware that there are two kinds of cattle lice. The little red fellows are very troublesome to get rid of; the larger black louse is not so troublesome.

Mr. Marshall. It makes no difference whether they are little or big, they will all go.

Mr. Lord. I have never had trouble in getting rid of blue lice, but the red lice have troubled me considerably. I have sifted dry dirt along on the shoulders and back. You can open the hair and see them there all alive. They don't keep still, like the blue lice; they are in motion all the time. I have put on sulphur, and tried one thing and another, and none of them seemed to do any good. I think the best preventive is good keeping. If I keep my stock in good condition, in good flesh and good order, they do not have any lice. I have filled my barn with hay and rowen, and I do not expect to see any lice on my cattle this winter.

Secretary Sessions. Another question: "Can any one tell whether cream has been tampered with before it is drawn from the can?"

Mr. ——. This is a matter of more importance, perhaps, than would seem at first thought. On Monday morning I was informed that the milk from a herd that had been giving from nine to ten spaces of cream very suddenly rose to sixteen. This cream was taken to the creamery, and the butter-maker churned it separately. It took between nine and ten spaces to make a pound of butter, whereas the average of the creamery was six and a half. There has been some little improvement in the cream since, but it has not got back where it was before. Another creamery in Western Massachusetts I understand has had the same difficulty. They finally suspended the party for fifteen days, and that cured him. Now, before taking any action in the case to which I have referred, it seemed to me it was possible that some gentleman could give us a certain way of determining whether or not cream has been tampered with. In this case the cream had evidently been stirred.

Mr. Dyer. A bit of information came to my knowledge casually about a year ago, that may help the gentleman out of his difficulty. I had a hired man who had been in the employ of a party in Connecticut who furnished cream to one of the co-operative creameries there, and during the year that he worked for me he told me casually one day something about his employer, and that a part of his work was to turn so much fresh milk into the cream on each can every morning, to increase the number of spaces before it was taken away by the cream-gatherer. That may help the gentleman to understand how it is done. In this case the cream was not stirred, but fresh milk was turned right into the cream, so as to increase the number of spaces.

Secretary SESSIONS. Mr. Gold, Secretary of the Connecticut Board, has had some experience in the distribution of milk and cream, and we should be very happy to hear from him on this subject.

Mr. T. S. GOLD of West Cornwall, Conn. I have but very little to say on this subject; but I understand that the practice to which the gentleman refers, of pouring new milk into the cream, will measurably increase the depth of the cream. That has been done, and parties have been detected in that practice in repeated cases. But just how you are going to tell in all cases whether or not cream has been tampered with, I cannot tell. In the cases to which I have referred, the deception was detected by noticing the unusual amount of cream that the milk registered, and then by churning it by itself, and finding the extra number of spaces required to make a pound of butter. The parties were then confronted with the facts, and were obliged to own up to the practice.

Dr. GOESSMANN. I sent out my assistants to some dairies, and they visited about two hundred farms and collected cream. We found that that cream varied in percentage from fifteen to twenty. I think the best test would be to isolate the cream from each farm. That would soon show whether the cream had an infusion of milk, or not.

Mr. JEFTS. In the creamery with which I have had some acquaintance we have found this trouble once in a while; and when we have run across it, or thought we had, we have collected the cream from that place separately, churned it, and if it took from eight to ten spaces to make a pound of butter, we sent word to the patron asking him to look the matter up. If, upon testing it perhaps a week after that, we got the normal amount of butter from the cream, we felt that we had met the difficulty.

Secretary SESSIONS. I have another question here: "Considering the magnitude of the poultry interest of our country and the importance of artificial incubation to the poultry keeper, why can we not have something done at our experiment station for the benefit of this great industry?" I think Dr. Goessmann can answer that.

Dr. GOESSMANN. That is something entirely out of my line of investigation.

Secretary SESSIONS. I have one other question here: "Man being an animal, why should our food be cooked, at a loss of its digestibility?" I believe Dr. Lynde understands that question.

Dr. LYNDE. It ought not to be cooked at a loss of its digestibility. The purpose of cooking food is to render it more digestible. The human stomach is altogether a different stomach from that of the ostrich, of the ox or of the sheep. Its mode of operation is different. The juices that it secretes that digest the food may be analogous to those of the ostrich or those of the animal; but when you ask the human stomach to take uncooked root fibre, digest it, and convert it into a pabulum which will nourish the tissues, you are asking too much of it. The human stomach will not do it. That food must be prepared for human use by cooking, and by proper cooking it loses none of its important elements; its digestibility is wonderfully improved, and the digestive juices that are secreted in the digestive apparatus of the man are enabled to act upon that food, to dissolve it, to pabulize it, and to put it into a soluble condition, so that it can be absorbed into the system, be assimilated by the tissues, and be used for the purposes of nutrition, of repair, and for the purpose of maintaining that most wonderful function of human bodies, animal heat. So that it is important that the food which we eat should be not only carefully selected, but that it should be well cooked, properly cooked, not spoiled by cooking. It is from this that we derive our power to work. Whether we work with the muscles or with the brain, we derive our power from the energy that has been stored in the food that we consume; and that food must be supplied to us in such a way that we can digest it and appropriate it, and we cannot do that successfully unless it is properly cooked.

Mr. Peterson. If there are any exceptions, doctor, I suppose they would be in favor of fruit, especially for the young?

Dr. Lynde. As a general rule, it is better that fruit should be cooked. I am not certain but that, as a general rule, that wonderful substance which you have been talking of this afternoon, that is so perfectly elaborated in the lacteal glands of the cow and of human beings, — I am not certain that that wonderful fluid may not be rendered more digestible, more acceptable to the human stomach, if it goes through a slight process of cooking. That is to say, it is altogether probable, indeed, I think it is altogether true, that milk, when supplied to the human young or to the older person, is made more digestible by heating it up to a certain point, say to the point where the milk begins to simmer around the edges of the dish in which you are heating it. But if you boil that milk you change its properties; it is a different substance from what it was before.

Allow me to digress for a moment to something which is practical, and, to my mind, exceedingly important. You are all aware that a great deal has been said in the last few years, both in this country and abroad, in relation to the subject of tuberculosis in cattle and in hogs. A great deal has been said, a great deal has been written upon it; and it is a subject which comes right home to every man, woman and child in the community. It touches the welfare of the community at its start, at its root; and if it is true that we are liable to take the germs of consumption into our systems, if it is true that children who are fed the milk of our cows are liable to get tuberculosis from infected milk,— and the truth of it cannot be controverted, — that being so, how important it is that the milk of the infant who receives its nourishment from the milk of an animal other than its mother should be administered in its purity; and if the child is in danger of taking tuberculosis from the use of tainted or impure milk, how important it is, if that can be prevented, that the facts should be known. Now, it is true that if milk is heated to the degree which I have indicated, that is, until it just begins to simmer, if it contains the germs of tuberculosis or of any other disease, it effectually sterilizes that milk, kills those germs, and renders that milk safe for the infant and safe for any one.

Now, just one step further. If it is true — and that it is true will not be questioned by scientific men — that the tissues of an animal which is affected with tuberculosis contain the germs of that disease, if it is true that those germs are in the blood and in the tissues of that animal, if it is also true that a thorough cooking of those tissues will destroy the germs of that disease, how important it is to the welfare of the people that the meats which they consume should be thoroughly cooked before they are set upon the table or eaten at our meals.

Adjourned to 7.30 P.M.

EVENING SESSION.

The meeting was called to order at 7.30, Mr. CRUICKSHANKS in the chair.

The CHAIRMAN. I have a very pleasant announcement to make to the members of the Board. It is that the secretaries of the boards of agriculture of the six New England States are now present in this room, a thing that has probably never happened before in the history of this Board. I have now the pleasure of introducing to you the Masonic Male Quartette, who sang so acceptably to us last evening, who will favor us with a song.

The quartette gave a song, which proved so acceptable that the audience demanded another, to which the quartette very kindly responded, and were heartily applauded.

The CHAIRMAN. The lecture this evening will be by Prof. Wm. H. Brewer of Yale University, upon "The Farm and Farmer the Basis of National Strength." I have the pleasure of introducing to you Professor Brewer.

THE FARM AND FARMER THE BASIS OF NATIONAL STRENGTH.

BY PROF. WM. H. BREWER, PROFESSOR OF AGRICULTURE IN YALE UNIVERSITY, NEW HAVEN, CONN.

The farm and the farmer are the basis of national strength. This is true of all countries, and is especially and emphatically true of this. National strength implies several things, — strength in material resources, strength in men and strength in intelligent patriotism. There are many factors in the problem of what constitutes national strength, — some are material, some intellectual, some moral and religious; and all these factors are related to agriculture as they are to no other one vocation or industry.

Our modern civilization is very complicated. It implies that there is and must be in any prosperous community a variety of vocations in which men busy themselves, a variety of industries in which capital is invested, and a variety of things produced. Inasmuch as this variety of vocation and investment is essential to a high state of civilization, there is one point of view from which we may say of several industries that each are necessary to a nation's strength. But there is another point of view, from which we see that these different industries have very unequal values, and that some of them are much more important than others as factors of national strength. But in every aspect and lying at the foundation of all the others, and upon which the prosperity and stability of all the others must depend, is the *agriculture* of the country. This is partly because of the nature of the capital employed in this industry, but more because of the nature of the product.

The subject has many sides and may be viewed from a great many stand-points, but from each and all of them the same conclusions must be reached. In the short hour assigned me now, we can only consider in a very general way some of the many elements which enter into this subject.

The Food Question.

The most obvious and pressing necessity of mankind is food, and the food of civilization is produced by the farmer. This fact of itself places agriculture in different relations to the community from that of any other industry. By the production of crops and the production of domestic animals all civilized countries are fed, and in the march of improvement and discovery we can scarcely hope that any other chief source of food supply will ever be discovered or devised. We must believe that in the future, as in all the past ages, the farm must supply the daily bread. This fact, of itself, were there no others, would be sufficient reason why a nation without agriculture could not be as strong as a neighbor which produced sufficient food for its own citizens.

In regard to the other productive industries, and especially in manufactures, this or that object may drop out of use or new articles come in; changes take place in the method of production as well as in the object produced; changes may take place in the objects and methods of trade in any community; but the farm and the farmer must ever remain of the same supreme importance to the community, because they feed the people.

In times of peace and with modern means of transportation, communities may now be fed from a distance, as was not possible in all the previous ages. Nevertheless, the fact remains that an independent food supply is a prime source of strength. No nation can be permanently strong that has not an assured food supply. It must either produce its necessary food upon its own farms, or else it must be not only rich enough to buy it from elsewhere, but also strong enough to defend it from possible enemies while in transit.

An over-crowded land depending for any considerable portion of its food upon other nations has within it an element of weakness standing ever as a menace to the stability of the government itself. But one country in the world today is prosperous under such conditions, and that is prosperous only because of its supreme naval strength. This has made it possible for its commerce to continually increase, at the very time its agriculture has suffered. But that country has doubtless passed its zenith of relative strength, and what will be the future of England is a problem for the future to solve.

Capital in Agricultural Land.

Capital in agricultural land has always been considered in a different light from capital employed in other industries. It certainly bears a very different relation to national prosperity. It is the most stable of all kinds of property, and least liable to be totally lost. It belongs to its own country, and to no other. Capital invested in trade, even in manufactures, may, in times of danger, be transferred to other and more peaceful or more prosperous countries. Land in cities has its value entirely in the prosperity of the city itself; but agricultural land has a peculiar value of its own, and is related to the community as no other property is. It cannot be carried away in times of trouble, nor hidden out of sight from the tax gatherer. It is capital that must remain in its own country; it can neither be carried away nor entirely destroyed, nor can it be brought into the country from elsewhere. Like all other forms of capital, its money value fluctuates according to the vicissitudes of the business; but it is never entirely lost, so long as the nation endures or people are left to be fed. Hence the agricultural land of a country, as representing invested capital and national wealth, has always borne a somewhat different relation to the government than capital invested in any other way.

Curious and fallacious doctrines are now being preached regarding the source of the value of land. Men preach that it is the community and not the occupant that gives value to land, and even that land has an inherent money value of itself. This is practically untrue. As a rule, land has no value of itself. Agricultural land derives its value in part from the labor done on it, in part from the density of population, in part from the stability of government, in part from the character of the neighbors, in part from the nature of the market for its product, and in part from several other causes.

Private ownership of land appears to lie at the foundation of all civilization. The native American Indian had no idea of private property in land, in the sense of having the land divided up into parcels, each with an owner. He might indeed have his small corn patch, but the land as a whole belonged to the tribe as a whole. So, too, the parent had no exclusive right to his own child; it belonged to the tribe or to the "gens" or band. To civilize the Indian, we have to instill in him the Christian idea of a family, the Christian idea of private property belonging to the family, and, as a last resource, of individual ownership in land.

I am aware that a certain school of politicians, which denies the right of private property in land, is making much talk and is growing in this country. Starting with premises that have but a thread of fact, they reach conclusions as wild and fallacious as they are radical. This school of politicians is almost exclusively of foreign birth. It is an importation, and belongs to the city and not to the country. It is simply impossible that such a school could grow up on farms. It totally and entirely ignores the fact that agricultural land is as truly a manufactured product as is the house upon it or the plough with which it is tilled. Land in a state of nature is not fit for agriculture; it must be brought into a state fit for cultivation by labor. Take the land of this State of Massachusetts as an illustration. The labor expended on subduing the land and bringing it into its present conditions would amount to more than the land will bring to-day, even if that labor is not counted at more than twenty-five cents per day.

Land from which any man can earn a living if he sees fit to subdue it, clear it for ploughing, dig it and put in his crops, may still be bought in New England or even in the Middle States for less than a dollar per acre. We hear of farms "abandoned" in New England, which once supported a thrifty population. That is not a feature peculiar to New England. Land was sold last year in New York, the "Empire State," — not in a remote corner, but lying but a few miles from great cities, — for one cent per acre, and considerable quantities at less than one dollar per acre. I cite this merely as an illustration that land has little value of itself. A part of the agricultural value of land depends upon its proximity to market; a little depends upon its native fertility; but very much more depends in actual fact upon the ability and labor of the farmer. Some lands are so situated that they can and will have but a slight agricultural value; there are others that may have or may not have a high money value, according to the farmer who tills it.

Let me illustrate my meaning by citing a case described in the "Maryland Farmer," last year. It is the story of a farm near the city of Baltimore; it was well fenced, but was poor and run down. Its proximity to Baltimore gave it some value, and an enterprising farmer bought it for twenty dollars per acre. He took hold with a will. He raised such crops as he could market in Baltimore, and always took back a load of manure which he could get cheap. In a few years his farm was as fertile as a garden, and his crops of vegetables brought him in a nice income. He was a prosperous man, and was repeatedly offered two hundred dollars per acre for his farm, and once as high as three hundred and fifty dollars; but it was his home as well as his capital in business, and he kept it until he died. His heirs sold it for two hundred and twenty-five dollars per acre, and moved away. It fell into the hands of a careless man, who thought the farm should support him; he did little himself, but let his hired men do the work. The farm of course deteriorated. He was offered a hundred dollars per acre, and refused; he thought it worth more, and it certainly had been worth much more until recently; so, rather than sell at that price, he rented it. The tenant cropped it hard. In the end it was sold at auction for twelve dollars per acre.

This is a fair and typical illustration of the actual source of value in most agricultural land. Tilled soil is not a natural but an artificial product. It is something that is made, and its value depends on the skill, brains and industry of the man who manufactures it.

I have said that capital in agricultural land is never entirely lost. This is true simply because, if it ever had agricultural value, it may have it again so long as the market endures. In the case cited this great decline in the value of the land was not because of competition or loss of market. We hear much of the decline in the value of farm land in New England; many farms have declined in value, but others have increased. Some have declined because of new competition, some because of decrease in the density of rural population; but more have decreased because the thrifty men who once lived on them have died, and their sons saw more inviting fields of business enterprise in towns and cities or in the West, where land could be got for nothing, and which would gain in value by their industry more rapidly than the old New England farm would.

There are three essentially different ways in which agricultural land may be owned and held; namely, by the State, by landlords constituting a landed gentry, or by the farmers themselves. There is now much clamor that the land be owned by the State, and rented to those who till it, by the politicians who may control the public offices. But I know of no civilized nation to-day in which the land is so owned, nor does any case occur to me where a nation or people has risen to a high state of civilization without private ownership in land. If the State is to own the land, the State must have the right to rent it to whom it pleases; to say to this man, Live here, and to that man, Live there; it must have the right also, when it thinks the population becomes too dense, to export men when it pleases and where it pleases, otherwise there will be over-population in some places. The State ownership of land belongs to barbarism and not to civilization. It is the common kind of land tenure among savages the world over, and it is extraordinary that it should be revived so late in the nineteenth century; and there is need of a class of intelligent farmers owning the land they till, to meet and fight this growing political heresy. There must be private property in land, or there can be no progress in agriculture, and no liberty for those who till the soil.

Private ownership may be divided into two systems: first, where the land is held in large bodies by a privileged class, and rented for tillage by a class having restricted political privileges and holding an inferior social position; second, where it is owned by those who till it, and where it confers no special political privileges not conferred by other kinds of property.

Most of the land in the old world was held according to the first of these tenures until very lately, and much of it is still so held. On the continent the cultivators were and are still largely what is called a peasant class, — a class of inferior social position, and restricted in political privileges. Until lately they have owned but little of the land they tilled. Peasant ownership on a large scale is a comparatively new thing.

Unquestionably the best system of land ownership is essentially that which we have here in the United States; where it confers no especial political privileges, and where land may be bought and sold as other property can, with only such restrictions as the nature of the property and the security of title render proper.

Wherever such a condition exists, there we always have a sub-division of land, suited to the wants and the means of those who wish to win their living from it. The man of moderate means can buy land on the same terms that the rich man may. This tendency has been to create a large number of property owners, and this is unquestionably a source of national strength. We cannot conceive of a strong nation or any strong sense of patriotism, where all the people are poor and without hope of acquiring a home. Love of country grows out of love of home, and a nation of homeless men cannot be patriotic. National strength is, in a sense, based upon property as well as upon men; and no other form of property is so endearing as a bit of land, which is at once the home of the family and its wealth.

Less than a generation ago, seven-eighths of the capital of the civilized world was invested in agriculture, or in the commerce of agricultural products. The younger generation to-day cannot appreciate how rapidly the means of investment have changed. One of the reasons, and a powerful one, too, for the decline in money value of agricultural land all over Christendom, is due to the fact that many other ways have rapidly come forward in which capital may be invested with reasonable safety and profitable returns.

Perhaps the most marked feature of the employment of capital to-day is the tendency for its concentration in a few hands. Vast sums, representing the capital of great corporations, are controlled by a few people, and great riches have accumulated in the hands of a few very rich men. Less than a generation ago all the very rich men were rich in lands; it was almost the only stable property to invest in on a large scale that they knew of. But now, and especially in this country, the most wealthy men are not large land owners, and have not made their money from land.

In all the productive industries other than agriculture there is a marked tendency for the concentration of capital. Establishments on a large scale can be managed more profitably than on a small scale. In manufactories the product is cheapened and made more uniform. All this tends to concentration of wealth in fewer and fewer hands; and this very concentration, which separates more and more the interests of the rich and the poor, is an element of weakness.

The antidote for this, as a factor of national strength, is in maintaining the present character of our farming population. The hope of a wide distribution of wealth and the political power it brings, now, more than ever, rests on the farmers.

The outcome of the system of land tenure in this country has been to create a larger proportion of property holders, — a larger proportion of men who own their own homes than in any other country of the world. This has been a fact from its early settlement, and was a fact of prime importance in the time of the Revolutionary War. This was a war of farmers for their homes. Putnam left his plough in the furrow when he started for Bunker Hill; Washington went from his farm to lead the armies of the struggling colonies, he was recalled from his farm to be our first president. When this service ended, he set the example of retiring, not to a pensioned palace, but back to his farm. There he lived, honored as well as beloved by his country, there died, and there his bones rest. The Declaration of Independence and the Constitution of the United States were written by a farmer, who, when he finished his official work for the nation, returned to his farm, where he spent his declining years, where he died, and where he is buried. This is not the story of a landlord class.

During our whole colonial period and during the first century of the republic the great majority of our statesmen came from farms. I once took much pains to look up the history of the childhood of all the presidents of this republic. Of a few I could get no information; but at least sixteen out of the twenty-three presidents of the United States have been either farmers or planters themselves, or the sons of such. Ten of this sixteen were the sons of farmers, born and spending their childhood on small farms; and four of them, indeed I might say five, were on new or "pioneer" farms in their boyhood, actually helping in the arduous and toilsome work of subduing the wilderness to the plough. This is not the story of a peasant class.

Not only were the architects and builders of the American idea during the colonial period essentially farmers, but so were the statesmen the first seventy years of the republic; and I think there will be no dispute but that the increased corruption in national and State politics has grown almost in the same proportion as the domination of towns and cities has grown. As a larger and larger part of city-bred men came into politics, there has come with it an increased proportion of professional politicians, patriots in speech, but alas! too often patriots "for revenue only."

The strength of a nation must consist essentially in what many have been pleased to call its middle class, — those who were neither rich nor poor; those who must both work and make use of their own capital in their vocation. The farms not only have been, but must and will continue to be, the great home of the middle class in this country, — that class from which arises most of the men who take a leading part in all that advances civilization; the class from which springs the more progressive and the stronger men intellectually in all countries. I shall have occasion to refer to this again in several other connections.

The Farm as the Place to grow Men.

Country life has in all times been healthier than city life. In all previous ages of the world the human race has degenerated when aggregated in cities. This has been emphatically true of the larger cities, all of which have only been maintained by a continual draft of country blood. It has been said that no family survived in Paris more than three generations, without fresh infusion from the country. In England and on the continent all the "old families" had their country residence, where the children were reared, and where adults went to recruit the health and energies wasted in city life.

The relative difference is now much changed. Modern sanitary science, modern means of transportation of food, and modern means of obtaining comforts and materials (such as milk and fresh vegetables from the country), have changed the relations somewhat, and indeed these have made great cities possible. But for these contributions of science to the arts of life, the great migration of men from country to town, which marks the present time, would not and could not have taken place. Nevertheless, the superior value of the country over the city as a place for the raising of healthy and stalwart men, a place in which at least the childhood should be spent, has not been changed. Armies may enlist men from the cities, but practically their strength comes from the country. Then, too, in this country at least, the farms have supplied the most of the statesmen, the leaders in thought and the business men of the larger cities. So common is this, that wherever we see a man who has made great wealth in any of the cities, we take it almost as a matter of course that he spent his boyhood on a farm. And this brings us to the next point, —

The Educational Influences of the Farm.

I have, on another occasion and before another audience, discussed this matter at more length than I can here. It is a subject in which I have been intensely interested for many years. The hope of a nation is in the children, and therefore the most important business of a nation is the education of its youth. This is especially so in a republic like ours, where not only the prosperity of the country but the stability and very existence of the government itself is in the hands of the masses of the people, rather than in the care of a special and privileged ruling class.

Many factors are involved in the evolution of our government and of our greatness as a nation, the most important of which has been the social, the political and the intellectual status of the farmers. My own belief is, that without this the progress of this country would have been but little better than has been that of Mexico, of Central America or of the countries of South America. In all of these countries the farmers have been rated as a peasant class, or at least a class socially and intellectually inferior. The eastern United States was settled not by peasants but by a middle class, neither the very poor nor the very rich, — an excellent stock of men. All northern and western Europe was sifted to get this seed of the nation, and from the necessities of the times a great majority of our early population were farmers, or at least lived a part of the time on farms. Farming had, in this country, a respectability which it had nowhere else in the world. The large number of eminent men who originated or were educated on farms was the legitimate result of the condition of things, which has heretofore prevailed.

The subject of the educational influences of the farm has long been one of peculiar interest to me. I was born and reared on a farm; all the associations of my childhood and all the traditions of my ancestry related to the farm; so I speak from experience in that direction. I am a teacher, and have spent many years in teaching in academies and colleges which have had among their pupils both city and country youth; so I can speak from a teacher's experience. As an American citizen, interested in the history of our beloved country, I have studied the influences which have shaped its progress, and which have molded the lives of many of the eminent men who have shaped its destinies and made it great, and could but notice what a large proportion of them had received their education on farms. As professor of agriculture, the influence of farm life on the intellectual status of the people has naturally and necessarily come within the province of my professional studies. Lastly, and by no means of least importance, as father of a family of children growing up in a large city, the relative value of city and country education comes very closely home to me.

When any person comes prominently forward among his fellow men, — whether great in the world of finance, great as an author, great as a general, great as a poet, great in the realms of literature or science, great as a leader among men, — the first question that comes up is, What was his origin, how was he prepared for this great work, and what has been his education? This is a never-finished subject of discussion; and when any man becomes illustrious for any quality that makes men great, questions are immediately asked as to the influences which molded his early life. The newspapers tell us about his origin, and teachers and writers tell us what schools he attended. When prominent men die, their biographies are written, so there is abundant literature relating to the more eminent men of this country. Moreover, numerous special investigations have been made as to the origin of leading men in particular cities or in special vocations. I need not repeat statistics here, but all point to the fact already asserted, that thus far the greater part of our successful men have come from farms, or have had at least a part of their education there.

This morning I visited your beautiful library, the gift of an illustrious citizen; after leaving that beautiful building, I inquired about his history, "Where did he come from?" The answer was, "Originally from a farm." It seems to me I could have answered that before; for this is the story all over the land. Is there a free library established, a university founded, or any other work of wealth to bless men in the direction of aiding them to help themselves, nine times out of ten you will find the founders and benefactors originated on farms, or got their first impressions of life's duties and life's privileges there. Our land is dotted with schools and colleges and universities and libraries, founded by men from the farms.

From the fact that a relatively smaller and smaller proportion of the population is now being produced upon farms, this matter comes forward now with an especial interest and importance. This State made its famous history when the majority of its population were either on farms or had a country education. The last census tells us that less than four per cent of its population are now engaged in agriculture. A great responsibility rests on this four per cent, for upon the farming population must depend much of its future supply of men for its business enterprises, and, more than that, men especially interested in the stability of our institutions.

For the conservation of political institutions, as well as for the creation and preservation of material wealth, it is best that as large a proportion of the whole population as is possible own real estate, particularly their own homes, and that they be business men, even if on a small scale, working and planning for themselves. This our system of land tenure and land ownership encourages. For peace and the suppression of warlike impulses, as well as for thrift, it is best that as large a proportion of the population as is possible be at work for themselves rather than for hire ; and for this our system of farming furnishes an opportunity. It is unquestionably best for the race that a large proportion of the population have facilities in their vocations for the education and the rearing of families in industry and thrift. For such education no other industrial occupation is so especially adapted as farming ; in no other vocation is there exercise for so great a variety of faculties and for the cultivation of the judgment, as on a farm. Growing various crops, producing domestic animals, using the latest machinery and labor-saving devices, — here the child has a greater variety of object teaching than can possibly occur in any other common form of home life. The round of the year's labors has in it something to continually interest him. Crops grow and animals are reared, the natural laws and phenomena relating to the daily work are more obvious than in ordinary homes. The seasons mean more than merely heat and cold, and the weather more than pleasant skies or gloomy days.

In this farm education, the child sees the business of the father go on from day to day, and from a very early age he begins to take part in it and soon becomes a member of the firm. From the time he begins to feed the chickens or drive the cows, he becomes a working member of the establishment, and has a sense of responsibility in the management of affairs. His own importance is correspondingly increased, and along with it his sense of personal worth. The city child is made to feel by the adults of the household that he is a nuisance ; he is at the bottom of the little social kingdom of home, more useless by far than even the menials. He is always in the way. Not so with the country child ; he feels that he is a member of the business firm, sharing in its work and its responsibilities. In no other vocation can the child be so trained to habits of industry without detriment to his health or intelligence. No other place is so well adapted to a sound education for intelligent citizenship.

It has long been noticed that a large proportion of the more prominent business men in all cities come from the farm, or gained a part of their early education there. This well-recognized fact is but the natural and logical result of farm education. The child on a farm sees the business of the father go on from day to day, as the boy in the city does not. He sees what the work is, and what it is for. Although very varied in character, nearly all the work is an education in prudence and forethought. Most of the work of the farm he sees going on or takes part in is for future or unseen results rather than for immediate and obvious uses. Each and every step is an education in forethought, a making provision for the future. The ground is ploughed and grain sowed for a future crop; the winter's fuel is provided for in summer; fruits and vegetables are stored for use long months ahead; animals are anxiously cared for and reared, requiring months of care before they have much value; orchards are set out which will not bear fruit for years to come; and so on through all the varied work of the farm, — scarcely anything is for to-day, all of the operations are for the future.

The contrast between all this and the experience of a child in a city is great. City children see or know little of the business of their fathers, except in the most general way, and they see the daily wants of the table supplied without obvious forethought. Then, too, there is so much to tempt them to spend what little money they have, so few ways in which they themselves can see an investment grow, that it is no wonder that cities produce so many men without thrift. The whole education of the farm is an education in habits of industry and thrift; education in providing for the future, education in patience, in awaiting results. Success in life depends upon overcoming difficulties rather than in the avoidance of them, on industry rather than genius; and the education of the farm is eminently adapted to strengthen children in these directions. Even a small child can do something useful; what he does is not merely work devised to keep him out of mischief, but something that needs to be done; and the most of farm work is unlike the routine work in shops and factories, in that it is varied, interesting and healthful. In no other vocation can the child be so trained to habits of industry and thrift without detriment to his health, intelligence and self-respect.

Then, too, all this education is in connection with a home, and this lies at the very foundation of patriotism. A farmer's love of home is a love for a spot of ground around which cling tender associations, a locality as well as a family. We can easily see why a farmer should love his home, and why in a time of danger he should be ready and willing to fight for it. The inhabitant of a city has an entirely different conception of home. With him, home is a family, and not a place also, for the family lives now in this street, now in that; and it is hard to have much sentimental love in time of peace, or patriotism in time of war, fighting for a rented house in a brick block, no matter how elegant may be its appointments or how great its conveniences.

More than one writer, both ancient and modern, has alluded to the fact that the inhabitants of cities lack patriotism; and this is but natural, when we consider the instability of a city home as a place of abode. Most of the business of a city can be transferred to some other place and carried on there; the farmer's work is associated with a place, and that place is at once the place of business and the home. Hence, that patriotism belongs more especially to the country and the farm than to the city, is but the natural result that comes from the different vocations of men, and the different educational influences brought to bear on the work.

We have a class of writers now who speak as if it was a matter for wonder that so many of our former statesmen and poets were born on farms. But could it have been otherwise? What would Whittier be without his farm birth and farm education? Thoreau was born on a farm; his parents soon moved into a village, but, it is said of him, as of Emerson, that he drove his mother's cows to pasture, and barefoot, too. Longfellow, Holmes, Bryant, Irving, Cooper, in fact, all of our best-known writers, have either spent a part of their childhood on farms or else in some country village, where they had abundant opportunity for observation in farm life. We might indeed ask the question, Would it be possible for a writer or a poet of any great eminence to arise whose only experience was a city experience?

Daniel Webster, a farmer's son, spending his days on a little farm and his evenings studying by the firelight in the little farm-house, is often held up to us as a wonderful picture; it would be vastly more wonderful to picture him as the son of a man living in the city, on the small salary of a clerk or the moderate wages of a working-man, the boy by day in some crowded school of the great city, his evenings in the street attracted by the sights and the distractions the city affords. No, great men do not come up in that way, and these men are not mere accidents; such growth as theirs has its foundation deep down in the laws which govern the development of human intellect.

Many good people think that the reason why the country is a better place morally to bring up children in (and particularly wayward children) than the city, is because there are fewer temptations. This idea has only a small basis of truth; all places have their temptations, — the city one kind, the country another; but temptations are in both. This theory is a relic of that old monkish idea, that the way to make a saint of a sinner is to remove him from temptation, — shut him up in a monastery, where the allurements and sins of the world cannot reach him; but great men are not developed in that way; the growth of character is a positive and not a negative process. It is what the country lad does, what he learns, and the strength he accumulates and develops, that makes him. It is not what he avoids and shuns, but what he meets and overcomes, that gives him strength for the battles of life; the rugged strength and rugged morals developed along with the work of the farm are his arms and his defence in the battle of life.

An Independent Middle Class.

The stability of American institutions must rest on the existence of an independent middle class, numerous enough to be powerful by their votes, and with convictions strong enough to maintain the laws which they may pass; a class not rich enough to constitute a purse-proud but weak minority, whose strength is only in their wealth, nor poor enough to constitute a class dependent on the more wealthy for means of a livelihood. It must rest on those with property to protect and homes of their own to cherish and defend. It is not too much to say, that in the future, whatever may have been the history of the past, civilization itself must depend upon the strength of this middle class. All the great men who advance civilization and shape the destinies of the nation are now produced in this class. The men of science, the writers, the discoverers, the inventors, very nearly all the authors and poets, statesmen in peace and generals in war, are born in this class.

This country achieved its independence because of the intelligence of this middle class, who had made farming respectable as it was then in no other country of the world. It has maintained its independence because of the advantages and inducements it has offered to this class; it has made its great material prosperity because it gave so many men a chance to rise. The farms have produced a stalwart race of educated men, whose early education in industry and thrift has given us material prosperity, and whose independent convictions have been the bulwark of our liberties.

Much has lately been said implying that the rapid growth of our national prosperity has been mainly due to the relative sparseness of our population. We all admit that this has been a factor, but I do not for one moment think that it has been the chief one. I believe that it is mainly due to the character of our farming population. Our near neighbor, Mexico, is surely rich in resources; she had the start of us in time of settlement, — with that start, why has she not grown and overshadowed us? With one of the most delightful climates of the earth, why has she not drawn to her the choice of intelligent and ambitious emigration? With scenery ranking with the grandest on the globe, why are there not more writers and poets developing amid her scenery, and drawing inspiration from the glorious surroundings? For the very best of reasons; *her farmers are peasants*, — not an independent *middle class*, but a dependent *lower class.* She has therefore lacked, not only the breeding-ground for great men, but those grand educational influences that have blessed the farms of the United States. That the country should have been feeble, that frequent revolutions should have taken place, property be insecure and administrations unstable, has been the natural and legitimate result of an attempt to found a republic on an ignorant peasantry. Just now there is a clamor to change New England farming, and introduce peasant farmers. A peasant class tilling our farms would be one of the greatest calamities that could befall our State or nation; our future hope lies in maintaining on the land an intelligent class of farmers.

Agricultural Depression.

There is great agricultural depression at present in New England; the vocation of farming is here under a dark cloud. The farmer must toil harder and for lower profits; moreover, despite his labors he often sees his land decrease in value; hundreds of farms in New England are to-day worth scarcely half what they were some years ago. The wise politicians and the still wiser newspapers are discussing this matter as if it was an isolated fact, belonging only to New England, and are offering wise reasons as to the cause, and suggesting nostrums for the remedy. One tells us the cause is the tariff; another, that it is the Western competition; another, unjust discrimination in railroad freights; another, the manufacturing of oleomargarine and similar productions. Another class traces it to moral and social causes; that the Puritans were a narrow set of men, too narrow to succeed, and were a failure, and now must make way for the more liberal Irishman or French Canadian. Some city writers trace the New England farmer's decline to his miserable domestic habits; he eats pies and that destroys his digestion, and the decline of his farming follows as a matter of course; and so on through a vast cloud of causes, some of which are undoubtedly factors in the problem, others mere whims or fancy.

The agricultural depression of New England is not a mere local fact; it is part of a great depression of the industry, which extends all over Christendom, except in new regions, and the causes are general, not local. It is in the West as well as in the East, and cattle growers of the plains and wheat growers in Dakota are complaining as loudly as the New England farmers. It extends to the old world, and those countries once the most prosperous in agriculture feel it the worst to-day. It is worse in Old England than in New England; Germany is groaning under it, and France is bemoaning it. It is sending thousands of depressed peasants from sunny Italy to our shores, hoping to escape the pressure that has fallen on them there. The causes for such a wide-spread condition of things must be also wide-spread. They are not local, and the disease cannot be cured by any local remedy.

The politicians in all the countries are seizing upon the facts to gain advantage for their own views, promising to cure the trouble by local legislation. In the United States and New England we are told that our agricultural depression is caused by our protective tariff; in Great Britain and Old England the politicians say it is caused by their lack of a protective tariff, — they attribute it to free trade; in Germany the politicians tell the peasants it is caused by a standing army; in France they are told that it is caused by the overbearing attitude of Germany; in Italy, because of a change in the political status: and so on, here one thing, there another; but in each case the remedy they tell us is to be brought about in some political way, by a change of administration or by local legislation.

The real causes are economic, and belong neither especially to tariff nor to no tariff, to republics, limited monarchies or absolute monarchies. The cause lies in the changed relations between the city and country populations, which have been brought about by three great factors that are the results of modern science and modern invention. First, and most important, are the new methods of transportation both of men and of products. Food can now be transported great distances very cheaply, and in good condition. Great cities may now be fed to an extent that has been impossible in all previous ages. Second, sanitary science has made it possible to guard cities against desolating pestilences, and to make them almost as healthy as the country for a working population. While the country still maintains its supremacy as a breeding-place for a healthy population, nevertheless, the adult individual can now live apparently as healthy a life in the city as in the country. These two causes have made cities not only more safe places of abode, but also more comfortable places. Once the country was the pleasantest place for the poor man and the man of moderate means to live in; now it is the city. Food is cheap and varied; even such fragile and perishable materials as fresh milk and eggs are abundant and cheap. The streets are paved, sewered and well lighted, and water brought into every house. These comforts have had very much to do in directing the population to cities. Third, the quick transmission of intelligence by telegraph and telephone has given especial advantages to cities for trade.

The combination of these three chief causes with various minor ones has resulted in the rapid growth of cities and large towns, at the expense of the rural population all over the Christian world. This has so changed farming that there is a re-adjustment of the methods of farming, of the markets and of land values going on in all countries reached by steam and telegraph, and wherever there is freedom of occupation.

Agriculture is the most plastic and adaptive of all vocations, and at the same time the most conservative. Unlike other industries, it cannot be killed by the most hostile legislation or the most oppressive conditions. It is so plastic that it molds itself to every pressure and conforms itself to any settled condition, no matter how hard. This must be so, for men must be fed; consequently agriculture goes on in some shape wherever civilization is found. The methods of agriculture adapt themselves to local conditions, and the business goes on in some shape so long as there is land to till and mouths to feed. Manufactures and commerce may be destroyed by hostile legislation or unfavorable conditions; agriculture cannot be destroyed without the destruction of the people; it can be changed, but it cannot be killed. But bear in mind that it is a conservative industry, and changes but slowly.

The history of agriculture in any one country is a most interesting study, and because of its vitality and its adaptability is always intimately related to the history of the nation itself. It is always changing as the conditions change, and the present agricultural depression is because the conditions of business in the civilized world have changed more rapidly than this conservative industry could follow. The introduction of steam for the transportation, the building of railroads and the changes in land transportation which have followed, have been the greatest factors in the change demanded of agriculture. Until within the memory of many of my hearers nearly all the food of the world had to be grown within twenty miles of the place where it was consumed. Only grain and such kinds of food as could be transported dried or salted could be shipped any considerable distance, and these at a considerable loss as to their value as food. Consequently, great cities could not be fed; moreover, under the conditions of life in great cities, pestilences were frequent and life much more uncertain than in the country. Consequently, there was not a city of a million of inhabitants anywhere in Christendom at the beginning of this century. The great growth of modern cities and the great drain of the rural population to large manufacturing towns has come about since the use of steam as a power for manufacturing instead of water power, and with modern means of transporting food and products of manufacture, and with the greater healthfulness of cities made possible by the application of sanitary science.

These great economical changes have affected agriculture everywhere, as they have no other industry or vocation; not only affected its methods and its products, but also its capital. Less than fifty years ago, three-fourths, if not more, of the capital of the civilized world was invested in agriculture or in the commerce of its products. Moreover, in most countries and emphatically in this, the vast majority of the inhabitants devoted to it at least a part of their daily toil. Now there are so many other ways of investing capital, some of them absorbing such vast amounts, that the value of agricultural land has declined. Once land was considered the only safe investment; this gave it a fictitious value above that which it would have merely for agricultural uses. This is shown on a stupendous scale in England, where land had also a political and a social value. The various causes which enhanced the money value of land above its mere agricultural value have greatly changed within the last few years.

Bear in mind that the money value of land depends upon a variety of considerations; partly on the density of the population, partly on the desirability of location for business purposes, partly on the markets, partly upon fertility, partly upon the character of one's neighbors; and so on through a variety of conditions, its agricultural capacity being but one factor.

In the new order of things, land is becoming relatively much more valuable in cities and less valuable in the country. Many kinds of business formerly carried on in the country have left the country, and the land of the country is rapidly becoming mere agricultural capital, and subject to the laws of capital invested in other kinds of business. Keep in mind that farming is the most adaptive as well as the most conservative of all industries. It can and will change to meet any required condition or pressure, but *it cannot change rapidly*.

As in all other kinds of business, change means a re-adjustment of the money values of the fixed capital used in the business. In some places land must and does rise in value; in another, sink, in accordance with the new conditions under which each farm is placed.

We hear much of the decadence of New England farming, and all the great city newspapers are just now speaking of it. They treat it as if it were an independent economical fact, and this decline of farming in New England has been the subject of many a pathetic article. But is it a fact that New England farming is declining, in any other sense than that which applies to agriculture all over Christendom? If so, in what sense is it declining? It is *changing* unquestionably; so is the farming of every civilized region that is reached by railroads and telegraph. New England farming is certainly changing, but I question very much if it is declining; I mean declining in the amount of its productions, declining in the value of its productions, or declining in its *relative profits as* *compared with farming in other places*, or even with many other kinds of business. No safe investment pays so well to-day as it did twenty-five years ago. It is more difficult now to make safe investments yield five per cent than it was then to yield seven or eight per cent. I believe from all the data I have been able to collect that New England as a whole is not declining in its agricultural productions, either as to amount or value. It is certain that this State of Massachusetts is not.

Massachusetts' Agriculture.

We have a census of agricultural products of Massachusetts, beginning fifty years ago; that is, going back to before the days of railroad transportation, and before the days of reaping machines or telegraph. I have spent much time and study on agricultural census tables in general, and of Massachusetts in particular, because this State is the only one in New England which has a census of its own, alternating with the national census, and more complete than that in its agricultural details. This is a rich theme for study, but I can only glance at some of the facts which have an especial bearing on the subject I am discussing.

The figures show that during the last ten years, the years of greatest agricultural depression, not only in New England but elsewhere, the total production did not decline, but actually increased twenty-eight per cent; during this period the total area of land in farms increased, the acreage of cultivated land increased, and the number of persons employed in agriculture increased. The decline, if there was any, was not in the amount of land tilled, nor in the number of persons employed, nor in the value of the products produced.

If we look at the whole period of fifty years, the results are very instructive. There has been an enormous increase, instead of decline; some things have greatly declined, especially mutton, cheese, wool and some other products; but even grain-raising has declined less than is popularly believed. I have constructed tables showing the amount of each of the cereal grains produced in each of the census years, and also the total amount of cereals. The tables would be too extensive for this place; sufficient to say that the decline, even in grain, has not been great. Using only round numbers, the hundreds of thousands of bushels, the decline has been from 41 (hundred thousand bushels) in 1840 and 29 in 1845, to 28 in 1880 and 31 in 1885. On the other hand, there has been an enormous increase in many productions. For example, eggs, from less than $26,000 in 1845 to over one and one-half millions in 1885, — an increase of sixty-two fold. Hay has doubled in value; milk has increased from less than $305,000 in 1845 to ten and one-third millions in 1885.

I cite these figures more to show the changes in our agriculture than to show that there is not a relative decline; because I wish to impress the fact of the actual change going on in our New England farming, and also the fact that, even rapid and great as it has been, it has not been fast enough to keep up with the changing conditions.

Farming is certainly changing here, but the change in New England is not so great as it is in Old England, nor is it, after all, attended with so much distress.

In the re-adjustment of values that is going on, many individual farmers have suffered because of the decreased value of their capital; but such decrease may take place in any business. With some kinds of business the industry would be destroyed; farming cannot be destroyed, it only suffers. It can change, but just now it cannot change as fast as the external conditions are changing. *That is why so many suffer.* It is changing in obedience to laws as imperious as the law of gravitation, but just now the pressure is greater than ever before. Greater changes have been demanded of it in the last forty years than in the whole preceding four thousand years, and more in the last twenty years than any two centuries ever asked of it before. This most conservative of industries has not been able to change as rapidly as the business of the world has asked it. Hence the distress; and here is the real explanation of what seems a most anomalous fact.

Civilization is going on, the population of Christendom is actually increasing; people must eat, there is no loss of market as a whole; and yet this industry which supplies the food for the increasing population and developing civilization of the world finds itself everywhere in distress. Even its capital is declining in value, and the farmer has for the past years been doing business on a falling market. There is agricultural depression all over Christendom, not merely in New England, but everywhere; and the real explanation I believe to be in the great economic law affecting agriculture, which I have mentioned; that, while it cannot be killed, and while it can and will change to suit new conditions and is now changing to suit them, simply because of the nature of the vocation, it could not change fast enough to prevent suffering.

As a matter of fact, it changes faster here in New England than in Old England, and there is actually much less agricultural distress. The English farmer is so tied by the renting system that he is not free to turn himself under these new burdens. The abandonment of tilled land, so called, which means the change from tilled crops to pasture or woodland, has been much more extensive in Great Britain than here, and land incomes have decreased more rapidly; but they, too, are adjusting themselves to the new conditions as fast as the nature of the case allows.

For nearly twenty years there has been a great and rapid decline in the renting and sale value of English agricultural land. A statement in a prominent and reliable English journal, scarcely a month ago, says that the loss to landlords has amounted to nine hundred millions sterling, and to tenants one hundred millions more; in the language of the paper, "the total loss, adding the two together, being about one billion pounds incurred in the last twenty years." That makes the enormous sum of five billions of dollars; and that loss has taken place while other business interests have been prosperous, and the population and total capital of the country steadily increasing.

The American farmer, who owns the land he tills and is free to change his methods and his crops, easier adjusts himself to the new condition of things; and yet the decline in agricultural land has gone on in all the older States. One writer says that it amounts to a hundred million of dollars in Michigan; another, twice that in New York; another states high figures as to the decline in Illinois: and so the story goes. Another class of writers is discussing the amount and number of mortgages on farms, and is trying to make political capital out of it; but foreign papers tell us the same story of France and Germany and Italy. We all know how Italian peasants are now seeking relief by flocking to America.

The fact cannot be denied that farming is under a cloud, and has been so for the last few years; but I believe that the bottom of the decline has been reached, at least in this country. The United States has given away land, and the old States have had to compete with land that cost nothing. But the land is practically all given away now, the "frontiers" are gone. So, too, the pasturage is taken up, and hereafter land must be *bought* for farming, and New England farms will again rise in value.

Farming cannot be killed; it must and will go on; and this very conservatism which makes it so difficult if not impossible to change rapidly, while the source of distress now, is, after all, an element of great value to a nation.

A Conservator of Conservatism.

In these days of radicalism and revolution, with free preaching of communism, socialism and anarchy, we need a large conservative class for the conservation of the institutions of civilization. This class, to be of sterling value, should own the land they may have to defend. It must be a class intelligently conservative; a class politically independent; a class having property to lose and homes at stake. Paris suffered at the hands of a commune composed of those who had nothing to lose by any change of government or any destruction of public or private property.

There is a similar dangerous class in every large city. It is essentially a *city* class. Anarchy preaches only in cities, where there are great and obvious contrasts of wealth, and where there are abundant opportunities for dissatisfaction. There, bodies of dissatisfied men get together, talk over and magnify their grievances, and come to think that their more prosperous neighbors are their natural enemies. Cities are the natural breeding-ground of political disturbances. The old saying, that cities were great sores on the body politic, is just as true to-day in a republic as it was when spoken of cities under monarchies. Hence it is in cities only that anarchy and socialism are extensively preached. Those who preach the doctrine that there should be no private ownership of land, that a man should not own even the home he lives in; who think that the chief value of agricultural land is given by the neighbors, and not by the owner's industry, and that all farms should be rented to the farmer by the State, — are all of them men who never worked on a farm. They never with hardened hands cut down and subdued the forests to the plough; they never with aching backs picked the stones from the reluctant soil; they never planted orchards that their children and children's children might eat the fruit thereof; and they have most extraordinary city notions as to wherein the real value of agricultural land lies.

This doctrine is a foreign importation; but, in a free country like this, there will always be such a class preaching heresy and working mischief. To meet them and successfully resist them, we need an intelligent, conservative class of land owners.

American farmers were framing and adopting a constitution and peacefully electing a president, just as the French revolution was raging and the government being destroyed. American farmers kept American politics cool and the land peaceful, while that country was suffering under revolution and blood. There, ignorant *peasants* were striking wildly for what they believed to be their rights; here, intelligent *farmers*, having achieved independence, were trying to preserve it by a new kind of conservatism, — a written constitution, something before unknown in the history of nations.

I had intended to speak of the present attitude of the city newspaper press on this matter, but time forbids; I can only hint that so many of them are in the hands or under the management of foreigners, whose education and associations are of a farming peasantry, that they begin to look at American farmers in the same light.

Under new and modern conditions, new forms of danger will continue to arise to the nation, when the country will need the same kind of strength that has been its preservation heretofore; that is, a powerful class of independent land owners, for the full and free development of men capable of being leaders in thought and politics, and for the conservation of law and order and property. This class has been, and must continue largely to be, the farmers. It is aided undoubtedly by the small freeholders of cities, men who own their own homes; but in larger cities this class is relatively becoming less and less. In the country villages and suburban towns it will remain and be an important factor; yet, for several reasons, it can never be so important as that relating to the occupants of farms.

I have only glanced at this many-sided question from a few points of view; I have adduced some of the many reasons why our nation's strength must be in its farmers in the future, as it has been in the past. More profound statesmen may see other deeper and more powerful reasons than I have given; but it seems to me that I have given enough to prove that, if this nation is to remain the free country it has been and seems destined to be, its hope is in an intelligent agricultural class.

Only this very week I have heard of the emigrant commissioner of a neighboring State trying to bring into New England, German, French, Scandinavian or Irish peasants, to occupy the so-called "abandoned farms" of his State.

I listened with intense interest this afternoon to the animated discussion over blooded stock. A speaker advocated the grading-up of the dairy cows of the State, and told how much it would add to our wealth and prosperity; but he was too slow for some of the impatient younger men, who wanted nothing short of pure-breds, and selected pure-breds at that, on their farms.

Yet within a week we see a great city newspaper telling us that the want of New England is *peasant* farmers. Out upon the doctrine that the country wants blooded stock, but a scrub race of men, on its farms! Sad, indeed, would be the day when New England will be tilled by a peasant class. Better let the lands be "abandoned," and stay abandoned; better let the forests grow anew and untouched, where the fox may dig his hole unscared, and the traveler lose his way in a wilderness, than that New England thought, New England culture and New England statesmanship, be turned over to a peasant class.

Adjourned to Thursday morning, at 9.30.

THIRD DAY.

The morning session of the third day of the winter meeting was opened on Thursday, December 5, at 9.45, Mr. Cruickshanks occupying the chair.

The Chairman. We had yesterday addresses from able gentlemen on the subject of the "Economical Feeding of Dairy Stock," and the "Grading-up of Dairy Stock." These lectures gave valuable information on the production of milk. There are a great many dairies where it is something of a problem to know what to do with the product. We are to have before us this morning the "Economic Disposition of Milk,"—following right in the same line. I have the pleasure of introducing to you Mr. Gilbert of North Greene, Me., Secretary of the Maine State Board of Agriculture, who will now address you.

ECONOMIC DISPOSITION OF MILK.

BY Z. A. GILBERT OF NORTH GREENE, ME.

The consumption of milk in its natural form in all cities and large towns commands the chief use of lands in the immediate vicinity of the consumption. This conforms to a law found everywhere associated with the business world. Every line of industry seeks a location where are to be found special facilities for carrying on its work; that the cost may be reduced to the minimum, a margin of profit be provided for the operator, and at the same time the product be placed on the market or before consumers at the lowest cost consistent with controlling conditions. In the milk business, next to production, the cost of transportation and delivery comes in as the principal factor. In obedience to this business law, milk production has taken possession of the nearest land available to its use. Hence the situation is as we find it. Farms near the cities are milk farms, and these extend out on the lines of cheap and quick communication till the limit of consumption is met, or the extreme cost of transportation allowed to the business is reached.

The first circle of farms contiguous to a town is usually given to a retail business, the farmers themselves transporting the milk by team, and delivering direct to customers. This gives the producer all the money there is in it, and makes the business an exceptionally profitable one. It is easily admitted that there is no other line of special farming pursued among us that proves so profitable, measured by money returns alone, as the milk business, where the profits of production are augmented by the profits of delivery, and the same man takes both. There are exacting requirements connected with it: the unseasonable hours; the never-ending confinement of the seven days of the week, and the three hundred and sixty-five of the year; the wear and tear of team; the petty trade with individuals; the vigilance required in collections; and the ever-occurring annoyances to which one is continually subjected. All these conditions, and many more that might be enumerated, demand a compensation. He who subjects himself to them is entitled to all there is in it, and receives none too much. With this kind of work I have no comparisons to make. As a rule, no one has grit, perseverance and iron endurance enough to keep him welded to the exactions of this business, with all its profits, longer than to carry him through an emergency, or lift him to comfortable circumstances financially. Having accomplished this much, these farmers, or milkmen, as they are usually denominated, fall back on some less exacting line of work, and make room for less exhausted energy.

Back of the delivery wagon lies the wholesale milk trade. In addition to the business law referred to, which calls the use of these contiguous lands to milk production, and which would under its mandates require that they be devoted to this product, there seems to be further causes for the wide attention given to the business over so extensive districts. Business is gregarious. Without stopping to study the causes or discuss the propriety of this, we simply call attention to its results. In sight of the retail milk trade the wholesale business necessarily starts up. The fact of the continued presence of this milk production in the locality where called for, naturally suggests its adoption by other farmers of the vicinity. Lines of transportation afford sure and quick communication, and so the business is invited out. Another farmer catches on because others are in it. Thus the circle tends to widen. This holds true around all milk markets, whether in the smaller towns or around the great cities. The extension goes on, till at last production exceeds demand. It is doubtful if a milk market can be found in a town or city anywhere, where the trade is not overcrowded with the product. This overproduction is the bottom cause of the continuous strife between producers and contractors, of which so much is heard. "Milk wars," the records of whose bloodless battles fill so much space in the columns of the agricultural press of your State, would never have been heard of had not the supply of milk exceeded the demand. Both arbitration and concession fail to establish permanent and lasting peace, for the same reason, and must ever so fail so long as there is milk that must be sold, and that knows no other outlet. Milk producers' unions may succeed in unloading a measure of the burdens upon the other side; but they can never establish a lasting peace, or bring about a reign of unbroken harmony, till they strike at the bottom cause of the unpleasantness.

Too Much Milk.

There is too much milk offered for sale. There are too many farmers engaged in the business of making sale-milk. It is my purpose at this time to call attention to other uses for milk than that of its sale as a whole product, and consider the money inducements there found for diverting it into such channels. Farmers make milk for sale because they have been doing so, and because their neighbors are in that line of business. They continue in the business for the reason that they suppose there is no other disposition of it so profitable. If it prove there are other uses for milk quite as remunerative, farmers have only to be informed what they are, when they will turn their attention in that direction, in place of wasting their energies in struggles with the contractors.

In starting out in the dairy business, if you will pardon a word personal, in a locality inaccessible to the milk trade, I had somehow, in common with the rest of mankind, imbibed the idea that a man so situated must work at a disadvantage, as compared with those who were so favorably situated as to be able to make milk for sale. Not liking to be outstripped by my fellow farmers, I was led to investigate the business of cheese-making and of butter-making, with a view to learning whether I would get left by pushing this work as a special feature of my own farming. Through my own work, and wherever opportunity afforded, I pursued these investigations, and with results that were a complete surprise, and which left me fairly well satisfied over my own situation. No one needs to enlist in milk wars to battle for prosperity. There are other fields of triumph quite as inviting.

Cheese.

Cheese-making affords an outlet for an unlimited amount of milk. Although Americans are not a cheese-eating people, yet here in New England there is room for much more of consumption than we are at present affording of production. Comparatively little of the cheese consumed here is made from our own milk. This is especially true in your thickly populated State, while in Maine the people mostly go without cheese. I once made a tour of observation across Washington County, eighty miles, without being able to learn of a single cheese made that year in the county. Since that time, however, I am glad to be able to say that the farmers have had their attention called to the business, and are now doing something at it.

I am aware this is an old-fashioned product of the farm here in New England, and that, for reasons not apparent to me, it is looked upon by most of our people as out of date. The impression seems to prevail that the making of cheese is only resorted to when and where people know no better, or where nothing else can be done with the milk. But there was never a greater error. Cheese-making, under proper surroundings and with the exercise of the business energy called into requisition in the milk business, will reward the operator with fair returns for the outlay, and better than is realized in some other branches of stock husbandry, where the cow is not introduced as a principal factor.

Factory.

There are two systems of work in cheese-making open to choice, a decision between which should be governed by circumstances and surroundings. With our small New England dairies, the associated or factory system is best designed to economize labor and keep the cost of making, curing and selling the product down to a low figure. The plan of building best suited for cheese-making has been essentially modified and reduced in cost of late, from those constructed under the teachings of Willard and Arnold, and other of the recognized dairy authorities whose efficient services were instrumental in first starting the business on the associated plan in this country. The building should be but one story in height, thus bringing work room and curing room both on the ground floor. The old-fashioned curing room, elevated to a place under, and immediately in contact with, a scorching roof, was a good place for roasting cheese, but not fitted for ripening it. An even temperature is necessary for this, and is best provided on a ground floor. A factory so constructed also costs less. An establishment equipped for working up five thousand to eight thousand pounds of milk a day will cost, constructed on this plan, twelve hundred to fifteen hundred dollars, according to locality.

The cost of making cheese in a well-conducted factory doing a full business, and all expenses included, is from one to one and one-quarter cents a pound, green weight. With cost of plant kept down to the lowest practicable limit, and business carefully handled throughout, the lowest figure named will not be exceeded. These are safe estimates, though it will take but little of loose and careless management to increase this cost essentially.

The North Turner (Maine) cheese factory, with the work of which I happen to be familiar, has made, since first started, a million and a half pounds of cheese. The quantity of milk required for a pound of cheese varies with the season, and with the condition of the cows from which the milk is drawn. In the flush of the watery and immature June grasses, with cows fresh in spring-time, ten pounds of milk will be required for one of cheese weighed from the press; while in autumn, with the richer milk peculiar to that season, and accounted for in part by the character of the food furnished, and further by the remoteness of the cows from time of coming fresh in milk, eight pounds of milk only is required for a pound of cheese, and in some cases the record has been made of a pound of cheese from only seven of milk. Nine pounds of milk from the common cows of the country, on the average, running six months of the year, will make a pound of green cheese. This shrinks from three to six per cent in curing, according to age when sold.

It may not be worth while to refer to the price of this product on the market, when all know that in the past, in common with all other commodities, its value has fluctuated somewhat. Any attempt, therefore, to name it for the future, would carry no certain reliance. It is, however, a law that has held good in the past, that no important commodity has long remained below cost of production; so we may reason that cheese will sell for a reasonable price. In view of the present indifference to this particular business throughout New England, the time when it can be feared that it will be overdone must be a long way in the future. The price for some years past has been called low; yet good cheese, — and intelligent Yankees are not excusable for making any other, — well sold, has averaged in Maine full twelve cents a pound. If a lower average must apply to Massachusetts, it must be because it was sold on the wholesale market, or was an inferior article. Here in Massachusetts, close as you are to a large population of consumers dependent almost entirely on other States for the product, and where there is no reason for going into the wholesale market, the price named is entirely safe to base calculations for the future upon. The price will go above that figure oftener than it will fall below. In Maine we have factories that never any year have sold below twelve cents, their product all going to the local trade or to consumers in the vicinity. With respect to market, we and you have an advantage in selling, with this commodity the same as with butter, only that it has not been worked to such an extent.

The North Turner factory, before referred to, in 1887, netted its patrons $1.15 per hundred for all the milk worked up for the season; and this when the greater bulk of the milk, remember, was made in early summer, when its value is always at the lowest. In 1888 the net was a trifle less; while the present year, not yet figured, it will fully equal that of 1887. There is no reason why a community of Massachusetts farmers cannot do as well as this (and probably better), provided they furnish as good milk and make as good a product. Nearly all home productions bear a higher value here than in Maine. I do not now recall any exception to this.

For milk made into cheese at a factory, averages would stand as follows: One hundred pounds common country milk will make eleven pounds cheese, green weight; which, ripened, shrinks six per cent, or, sold green at twenty-five days old, as much of it is, shrinks three per cent.

100 pounds milk makes 10.34 pounds cured cheese, at 12 cents, .	$1.24
100 pounds milk makes 10.67 pounds green cheese, at 12 cents, .	1.28
100 pounds milk paid in 1887, North Turner factory, . . .	1.15

There is a value to the whey product coming from cheese-making that should not be overlooked, though there is little reliable data to draw upon for facts concerning it. But dairying of whatever kind is dependent on attention to small fractions, and even so small a one as the whey should not be omitted. A certain milk farmer, sharp, as they all must be to make anything out of the business, boasted that he paid his taxes entire for the year on the half-cent per can additional he succeeded in getting from the contractor on his milk. The resulting whey from the cheese business must be worth that small figure, and therefore worthy of attention. The proteine compounds and the principal part of the fats are taken out of the milk by the curds; so, as a food material, the whey is not only extremely diluted, but is also one-sided in its contents, and for both reasons needs to be intelligently fed. The food nutrients left in the whey are not different from what they were in the milk, and are worth just as much for food. Whey should be fed combined with other nutrients of the proper kind, and never alone, as is too frequently done. It then is valuable to the extent of the food material in it. It is not proposed to make any figures on this value, but simply to call attention to it in passing, as a by-product of cheese-making, and worth something in the computation.

The weak point of associated cheese-making is the cost of taking the milk to the factory. This of course does not apply where the maker of the milk is located near the factory, but is quite a tax on those located a considerable distance away. True, it is no more when the milk is made up into cheese than if taken over the same distance to the train for sale, or to the centrifugal for creaming. But the tax is there, all the same. This kind of work, therefore, is best adapted to those localities where the supply is found within a limited circuit. Many New England cheese factories have broken down under the attempt to draw together small individual lots of milk from long distances. It has been proved, over and over again, that it cannot be done. Systematic co-operation among neighbors, however, will reduce this, in localities where it can be applied, to a cost that will not be burdensome.

Domestic Cheese.

It is not popular at the present day to advocate private dairy work of any kind. Cheese-making particularly is looked upon as out of date, and probably it is going with the spinning-wheel and the lapstone into the memories of the past. But it has not yet all got there, and the time may not yet be quite at hand when it should go. There are those left yet who are willing to engage in any honorable labor that will bring remunerating returns; and, if some of the old home work still pays the best, there seems to be no good reason why it should be proscribed. It is not my purpose to advocate a business that will overburden the household. I am dealing to-day with matters in which the common people of the country, the rank and file of the farmers, are concerned; and there are still those among them, though the number may be few, who have plenty of help in the family, and a part of which is at liberty to be directed where it will bring best results. I have in mind many such, and, to their credit, they are ready at all times to do their part in making the business of the farm successful. It is to such as can attend to its demands that this business of private dairying applies. Happily, in this work of making cheese it is found that the boys and the men can lend a useful hand in the labor, where girls are not plenty, and can relieve the women from the heavy work involved. In the country towns it has become one of the problems of the times, What shall be done with so many school teachers? The girls are all given a good education, and go out from the schools candidates for teaching. I submit whether it would not be quite as well for more of them to turn their attention towards these useful and profitable employments of the farm. If we are not careful, we shall soon educate the children to the idea that farm work is degrading. Cheese-making may still have a place on the farm.

Everyone knows, who has been seeking for top prices on the market, that there is a demand for articles out of season, and that people are willing to pay premium prices for the sake of gratifying this desire. Strawberries in February, "spring lamb" in January and "broilers" in April, are examples in illustration of this point. People anticipate the advent of summer in their desire for new cheese as well as in their demand for lamb and chicken; and the only reason the demand is not wider and louder is, that the girls are all teaching school instead of making cheese, and the call cannot be answered. There are many consumers who prefer new cheese to the ripened article, and they would use it the year around if it were on the market. As it is, some dairymen have caught on to the idea of early cheese, and are offering it to admiring consumers in advance of the general make, and at richly paying prices. It matters not how green the product, if the texture is such that it can be handled.

The private dairy work is particularly well adapted to this kind of dairying. In my own county there are a considerable number of farmers engaged in it, and there is no line of milk work outside the retailer's cart and quart that can match it. Cheese is put on the market as early as the month of March. In some cases provision dealers in your State have sought out our product, and secured a supply. In one case a contract was filled for January cheese. There can be no doubt but there could be built up an unlimited demand for this early new cheese in the many cities and large towns in your State. Some of the factories in Maine have taken up the business, and are prosecuting it with equally good results on near-by milk. The requirements, different from summer operations, called for, are simply a warm operating room, and a curing room artificially heated to the required temperature.

The private make is marketed at twenty to twenty-five days old, while the factory requires a few more days for ripening. Fourteen cents a pound is the lowest starting price now recalled, and frequently it has been some cents higher than that. The green weight and the high price combine to make the business a paying one.

It is possible to do better work in the private dairy than by the associated system. Milk never again is as perfect as when first drawn from the cow, and never again so well adapted to cheese-making. The less it is handled and the sooner it is curded, the more and the better product it will make. Taken as soon as drawn, there is no difficulty in grasping the fat of the milk and transferring it to the richness of the cheese. Eight pounds of milk, average for the season, will make a pound of domestic green cheese. In my own dairy, seven pounds of September milk from spring-fresh cows has given its pound of cheese; while, with hay milk from fresh cows in March, eight and one-half to nine pounds is required.

Computing the value of milk per hundred weight in this work as in the associated system, we have the following result: —

100 pounds milk gives early cheese ready for market, . .	11 pounds.
100 pounds milk gives average for season, for market, .	12 "
100 pounds milk gives September milk, for market, . .	13½ "
11 pounds early cheese, at 14 cents, ...	$1 54
12 pounds average for season, at 12 cents, ...	1 44
13½ pounds September and October, at 12 cents, ...	1 62

The cost of making cheese in the private dairy is difficult to compute, and I make no attempt. As usually carried on, the work is chiefly done by those whose time would not otherwise be employed in a way that would bring cash returns to the farm; and thus the dairy work becomes an opportunity to turn labor into a cash form, and for that reason is especially desirable. Whatever of money advantage comes from doing this work is saved by the farm and becomes a part of its income. Aside from the better product and the higher price, there is the advantage from private work, that the farm gets the benefit of the whole operation, — the cost of making and the net value of the milk. It is said there is an out to every good thing; there seems to be no out here, for this kind of dairying work can only be recommended where there is available labor.

Summer Milk.

One great advantage going with the cheese-making business, whether associated or private, is, that cheese is made on summer milk. All country dairymen in possession of low-priced pasture lands realize fully that summer milk does not cost as much as winter milk, and that a business that can turn summer milk to profitable account, without necessitating attention to winter milk, is an advantage. In this work there is no call for all-the-year-round milk. The object is to get summer milk, and all the work is shaped to that end. All the cows are arranged to come fresh in milk in springtime, when all nature aids them in doing their best; and to take their rest in winter, when the obstacles to cheap production are the most formidable. The cost of keep for cows run in this way is much less than when kept for winter milk, as they must be in case of milk selling. In my own herd, the cost of keep for a good cow run for winter milk, with feed reckoned at market values, is fifty to fifty-five dollars a year. The same cow, run for summer milk and giving a like quantity of milk per year, but doing it in less time, is kept at a cost of ten to fifteen dollars less. This leaves quite a margin for difference in the income for the year, without interfering with the profits, and is an important matter in connection with cheese-making.

Butter.

The making of butter is a business that may well engage the attention of any individual farmer or any community of farmers, wherever located. It is a pleasant line of work, and reasonably profitable to the operator from a money consideration. It is also of a nature particularly well calculated to preserve or build up the fertility of the farm. There is no product sold from the farm in our New England husbandry that removes with it so little of fertilizing matter as this one product of butter.

A comparison of the plant food removed from the farm by the sale of a ton of each of the following products illustrates the point : —

	Nitrogen.	Phosphoric Acid.	Potash.
1 ton English hay, ...	31. lbs.	8.2 lbs.	26.4 lbs.
1 ton beef, live weight, . . .	50. "	31.2 "	2.8 "
1 ton milk, ...	10.2 "	3.4 "	3. "
1 ton cheese, ...	90. "	23. "	5. "
1 ton butter, ...	.55 "	Ash, . . . 23.6 lbs.	

It is thus seen that butter removes practically none of that most costly of all ingredients, nitrogen, and but a small amount of phosphoric acid and potash combined. When the value of a ton of each of these several products given is considered, the distinction in favor of butter is still more apparent. As a conservator of fertility, then, there is no business that will match butter-making.

Factory Butter.

There are two systems of work in butter dairying. The associated, where the work of making the butter and preparing it for market is carried on at a factory or creamery, is the one now, properly, receiving most attention. By the way of parenthesis, I wish to say I never could see the propriety of giving a factory where butter is made, the name creamery. It is clearly a factory, as much as any establishment where products are worked up into other and more valuable forms. The word creamery, if it has an application, should designate an establishment devoted to the creaming of milk.

There are two rival methods of carrying on butter-making by the associated plan, — the one known as the separator system, and the other the cream-gathering plan. It is not for me here to discuss the question of which is the better. My work to-day is with the business, and not its details. Each has its merits, and each its place. The separator system involves the transportation of the milk to the factory, and the return of the skim-milk to the farm, — in this respect being precisely on a par with the cheese factory. In the cream-gathering plan the farm is relieved of all responsibility or cost of transportation, the cream being gathered by the factory, and the skim-milk left on the farm, where wanted. There is no form of dairy work that leaves so little of labor or responsibility resting with the producer of the milk as the cream-gathering plan of butter-making. In the transportation of milk, whether for sale or otherwise, there is an item of cost that cannot properly be omitted from this examination.

The price of butter must always remain an uncertain quantity, hence any calculations of value and comparison of profits must be made with a reservation. True, we now have in our factory records reliable figures on what has been done; but they may not strictly represent what we may be able to accomplish in the future. Besides, always and everywhere the outcome of the business depends, in a measure at least, on local conditions never common to all localities, and which give certain factories an advantage in price received for the product made which others equally well managed are not able to reach. Barring extremely high prices secured on account of local advantages on the one hand, and extremely low, from whatever cause, on the other, it is fair to the business to claim that the net average price per year paid per pound to patrons of New England factories has ranged from twenty cents to twenty-five cents. Comparatively few have touched either extreme. Probably twenty-two cents represents more factories than any other figures we could use.

The amount of milk required is also an uncertain quantity, for most of the factory work is gauged by measure rather than weight. Estimates in this direction should be made on common country milk, since this is the quality usually sold on the market. I understand the Boston contractors claim that a can of the milk received by them makes three-fourths of a pound of butter. If the milk taken by them comes up to the legal standard of thirteen per cent solids, it ought to do some better than that; but, taking their figures as a basis, twenty-four pounds of milk are required for one of butter. In our butter dairies twenty pounds of milk will make one of butter. We have, then, this calculation, figured on both twenty-four and twenty pounds of milk for one of butter: —

100 pounds milk, 24 to a pound, 4⅙ pounds butter, at 22 cents, .	$0 91
100 pounds milk, 20 to a pound, 5 pounds butter, at 22 cents, .	1 10
100 pounds milk, 20 to a pound, 5 pounds butter, at 25 cents, .	1 25

In the business of butter-making the by-product of skim-milk is an important item. This is all retained at the farm, or may be if one desires it; and, whatever its value, it should be added to the butter receipts, to give a fair presentation of the business. From a close study of its value through a long experience, I have come to value it one year with another at one cent per quart. As a food for calves and colts, a starter for pigs, or even a food for heifers in milk, it stands unrivaled. In some branches of this work it can be fed to great profit, and its value can hardly be expressed in dollars and cents. It also finds many uses with the family, and altogether is a convenient material to have constantly on hand for use. As a cool and refreshing drink in summer, one has only to become accustomed to it to value it highly.

Professor Jordan of the Maine Experiment Station gives the following composition of skim-milk as obtained by him, based on analyses made for five consecutive days, in each of six months, of the mixed milk of several cows: —

				Carbohydrates.	
Water.	Solids.	Ash.	Proteine.	Sugar.	Fat.
90.07	9.93	.80	3.51	5.24	.37

Milk of a quality requiring twenty-four pounds for one of butter will throw up seventeen per cent of cream. Of one hundred pounds milk skimmed for butter, there will be left on the farm eighty-three pounds of skim-milk, or thirty-nine quarts, worth thirty-nine cents to the farmer. The problem will then stand, as the value of one hundred pounds milk in butter and skim-milk: —

Sold at 22 cents per pound,	$1 30
Sold with 5 pounds butter to the hundred,	1 49
Butter sold at 25 cents per pound,	1 64

Dairy Butter.

There is still room for private butter-making, provided it is done on a large scale. While the market is reluctant to take small quantities of different makes of dairy butter, and will do it only at relatively low prices, yet, if the product be large and of fine quality, there is still room for it. With the exercise of energy in looking out a market, it is possible to secure a better average price than with the factory make. Where there is help at the farm to take care of all the work exacted, private butter-making, like the making of cheese, gives the producer all there is in the business. He shares no part of it with any one. There is, however, quite an expenditure involved in the marketing of the product; and, if one is not at work on a large scale, and favorably located as to distance from market, this tax upon his time will more than balance all advantages it brings.

Fertilizing Elements.

In considering the merits of any special business on the farm, the question of manure can never be ignored. Farming would be a royal business if we could go on indefinitely producing crops for sale direct, with no thought of the condition of the soil. But it can never be so. Manure for the soil is the first great question to receive attention, and the last to be neglected. In the milk business this enters as an important factor. Whole milk, 1,000 pounds, contains, in pounds: nitrogen, 5.1; phosphoric acid, 1.7; potash, 1.5. Skim-milk, found by Professor Jordan to contain: nitrogen, 5.5; phosphoric acid, 2.22; potash, 2.1.

In the sale of milk, all the ingredients of which it is made up go from the soil from which they came; while, in the case of cheese-making, a considerable portion are retained in the whey; and, in butter-making, practically all of the fertilizing ingredients are represented in the skim-milk, which is retained and fed out on the farm. A cow giving 8,000 pounds of milk in a year would send from the farm in sale-milk, in pounds: nitrogen, 40.8; phosphoric acid, 13 6; potash, 12. This would have a value at current rates of ingredients of commercial fertilizers of $9.55. A just comparison of butter and cheese making with the sale of milk must give credit for this excess material, so valuable to the farm.

Sale-Milk.

These facts and figures afford a basis for comparison between these different lines of work and milk selling; though, in view of the prevailing idea that these methods of coining money out of milk are entirely beneath the notice of the milkman, this kind of ciphering doubtless appears ridiculous on the start. I am informed, by the Secretary of the New England Milk Producers' Union, that the price of summer milk in Boston has been thirty-six cents per eight and one-half quart can, from which transportation is deducted, according to distance. To the inner belt of milk-producing country, or that located near the city, the business of furnishing the city with milk naturally belongs; and it must have an advantage there that never can obtain in the country. This affords the farmers so situated a profit in the business not open to the wide country. For this reason I have no comparisons to make with them. It is to the outer circle, where the farmers are trying, vainly, to overcome the disadvantage of distance, that we will give attention.

The cost of transportation for milk made in this outer circle, as given by this same authority, is twelve cents a can, which, deducted from city price, leaves twenty-four cents a can at the car door. This figure is subject to a further reduction, on account of surplus milk. I am aware this is a factor of uncertain dimensions, but quite sure, nevertheless, to have a place, and cannot for that reason be entirely overlooked. At least, if omitted in the calculation, it is sure to be met in the settlement. I am informed that during the past summer this surplus has amounted to nearly one-fourth of the shipments. This surplus creamed for butter is worth, say, fifteen cents a can, and this is a liberal value to give it.

On this basis the extreme prices would stand thus: best price, twenty-four cents per can; after deduction, twenty-two cents per can.

The actual price received would vibrate somewhere between the two prices, or net twenty-three cents. In a circle still nearer the city, transportation costs a cent less, but must stand a like deduction, which, on the same calculation, would net twenty-four cents. For this country supply of milk we make the following figures: —

100 pounds milk, at 23 cents per can,	$1 27
100 pounds milk, at 24 cents per can,	1 32

The cost of delivering milk to the train is estimated to average through a neighborhood two cents per can. Deducting this from above prices, would leave net at the farm: —

100 pounds milk, at 21 cents per can,	$1 16
100 pounds milk, at 22 cents per can,	1 21

Recapitulation.

Placing the results of this examination of these several methods of disposing of the milk product of the farm side by side, we have the following: —

One hundred pounds sale-milk at the farm in each of the outer circles of the Boston supply, —	
At 21 cents,	$1 16
At 22 cents,	1 21
At station, —	
At 23 cents,	$1 27
At 24 cents,	1 32
Made into cheese at factory, —	
Cured, at 12 cents,	$1 24
Green, at 12 cents,	1 28
North Turner factory paid,	1 15
Made into cheese at farm, —	
Early cheese, at 14 cents,	$1 54
Average for season, at 12 cents,	1 44
September and October make, at 12 cents,	1 62
Made into butter at factory, with skim-milk added, —	
Sale-milk butter, sold at 22 cents a pound,	$1 30
Rich-milk butter, sold at 22 cents a pound,	1 49
Rich-milk butter, sold at 25 cents a pound,	1 64

Butter-making and cheese-making are thus shown to be outlets for milk, independent of the sale-milk trade, that are well worthy the attention of farmers; and these opportunities are open to any who may see fit to go in and secure the advantages they offer. True, there is labor involved, but it brings its compensation. The milkman on his cart at four o'clock in the morning is willing to do it for the pay he gets out of it. The butter-maker or the cheese-maker has no right to ask for the benefits possible to the business, unless they render equally faithful service. This review shows, what is undoubtedly true, that there is not a wide choice between the different kinds of dairy work, only as that advantage is secured by obedience to exacting and laborious demands; so that, whether one or the other shows the larger margin of profit, depends more on the man than on the line of work followed. If the milk business is crowded, it is seen there is profitable work outside and room enough to carry it on.

I have chosen to take these commonplace and familiar products of butter and cheese with which to illustrate this fact. But the illustration need not stop here. We are but just entering the finer work that may be done with milk. The luxurious living, accompanying the higher civilization gradually but surely creeping upon us as wealth accumulates, demands the finest and the best that skill can produce, and in all the variety that the genius of man can supply. Even pure butter and fine cheese are new products with our people, and, up to the present day, are not plenty. The fine creams with their delicious flavors, and capable of indefinite variety, and the rich milks few have ever tasted, have only to be placed before the admiring palates of the refined New England people, to be appreciated in all their delicacy. Farmers may find abundant opportunity to seek out and develop work outside the familiar milk-can.

Secretary Sessions. You will recollect that our programme announces for this morning a paper on "Economical Feeding of the Wastes of the Dairy," by Joseph Harris of Rochester, N. Y. Knowing that we were to be disappointed in our expectation of having this paper, I asked

Professor Brooks of the Agricultural College to be here and help to fill the gap. I would like to have the professor take the time allotted for that subject.

Professor Brooks. Mr. Gilbert has spoken of the entire change in the production of cheese in farmers' houses by reason of the number of school-teachers; and he seemed to consider the subject simply from the stand-point that they should produce essentially the same kind of article that cheese factories produce, or that they should aim, as he said, to produce green cheese at the right season in order to get higher prices. Earlier in his remarks he called attention to the fact, well known to all of you, that Americans are not cheese-eaters. There is, I think, an important reason which is connected with our system of cheese-making. Our cheese-makers are not attentive enough to the requirements of the family. Our cheese factories produce cheese of enormous size. If the head of a family wants to buy cheese, he cannot buy a small cheese, he has to take a slice out of one of large size; and you all know how much of that is wasted before it can be eaten up. Our English cousins, the French and other nations, pay much more attention to the requirements of families, and produce small-size cheese, weighing from two and one-half to five pounds, of very delicious quality, which they offer to their customers; and, as you probably know, the English and French eat much more cheese than we do. Is not this largely due to the fact that they find in their markets an article which is much better suited to domestic use? It seems to me that this cannot be doubted, and I would suggest that the production in our families of higher grades of cheese, if they are of small size, is worth thinking of, at least.

THE ECONOMICAL DISPOSITION OF THE WASTES OF THE DAIRY.

BY WILLIAM P. BROOKS, PROFESSOR OF AGRICULTURE, AMHERST, MASS.

It is with extreme diffidence that I attempt to speak upon this subject in place of Joseph Harris, who, as you all know, has devoted a long life to its study, and who has had a varied and rich experience, upon which he would have been able to draw for illustrations and proofs of his positions. I cannot hope to fill his place, and shall endeavor simply to express a few thoughts, which shall serve in a manner to introduce a subject which is certainly one of the most important that Massachusetts farmers can consider.

That it is one of the most important, I think you will all agree. In co-operative dairying lies the best hope of the farming towns remote from large manufacturing or commercial cities and villages. That this fact is realized, is sufficiently evident from the steady and rapid increase of creameries in such towns.

The profits in the business, it is true, are not large. It is to be hoped they may become larger when oleomargarine is forced to "sail under its true *colors;*" but honest competition, even now always increasing, will increase yet more with enhanced profits. We have not in this comparatively new branch of dairying, then, an agricultural *bonanza.* We cannot allow wastes or leaks in this any more than in any business, — agricultural or other, — and hope to keep our heads above the current. We must make the best possible use of all the products of the business. How closely the animals slaughtered for food are worked up in the abattoir! Not an ounce is lost; not only the flesh, skin and bones, but even the blood, entrails, hair, hoofs and horns are all worked into valuable products. Even the chips of leather and the shavings of horns and hoofs come finally to the fertilizer-maker's vats.

At whatever business we look, the lesson is the same; it is by attention to what were once wastes that a profit is now possible. The farmer's occupation is not exempt from this necessity. It may some time come to be true, even if this be not now the case, that upon the skillful and economical use of the wrongly so-called "wastes" of the dairy (there should be no waste, but rather by-products), the profits of the dairy farmer will chiefly depend.

The business of dairying in all its branches is a close one; it is simply a good method of marketing our crops. We may not be able to figure a profit if we reckon food at market prices; but it should be remembered, that, without this or some similar business, these back-town farmers would be unable to market their crops. They could not find a profitable sale for the bulky hay, roots or corn which they can raise, save in the concentrated forms of butter and cheese or similar products. The business of dairying, then, must be here to stay. Let us see how its by-products can be most profitably disposed of.

The possible by-products of dairying are whey, buttermilk and skim-milk. It will be impossible, in the time allowed me, to treat the subject exhaustively; and I shall therefore confine myself mostly to a consideration of the possible uses of skim-milk, which is by far the most important of the three. This superior importance is due, first, to its much greater richness; and second, to its present and increasing abundance, as compared with whey. While butter factories increase in this State, cheese factories as rapidly decrease.

The superior richness of skim-milk will be evident from the following table, which shows its composition, as well as that of buttermilk and whey: —

Table of Composition.

	PERCENTAGE OF				
	Water.	Albuminoids.	Fat.	Sugar and Lactic Acid.	Ash.
Whey, ...	93.0	1.00	0.30	5.00	0.7
Buttermilk, . . .	91.8	2.79	0.21	4.36	0.8
Skim-milk, . . .	90.0	3.70	0.80	4.80	0.7

The superiority of the skim-milk is due to the much higher proportion of albuminoids and fat it contains.

We have, then, to consider how the dairyman can profitably dispose of his skim-milk. There are three leading methods between which he may sometimes take his choice, though in the great majority of instances circumstances will point clearly to some one as the best suited to the prevailing conditions. These methods are sale, manufacture into cheese, and feeding to animals of some kind. Of the first I shall say little. Whenever skim-milk can be sold for a cent or more per quart, this undoubtedly affords a greater chance for profit than any other method of disposition. It should of course be sold for what it is, and as such its sale and use should be encouraged. Not of course equal in nutrient value to whole milk, nor fit to take its place for infants, skim-milk is yet a wholesome food; and, if placed in the consumers' hands at a fair profit over the figures for which the farmer will gladly sell, it must prove a boon to a large class among our manufacturing population. For children above two years of age, sweet skim-milk must in many instances make a welcome and highly useful addition to their daily food; and, judiciously used in cooking, it must add vastly to the variety, palatability and nutritive qualities of the food coming to the tables of the workers in our cities and villages. When once skim-milk is appreciated by such classes at its true value, there must be a considerable outlet for this increasing by-product of the dairy in this direction; but at present the demand, though growing, is comparatively small, and but few farmers, even among those near manufacturing centres, are able to dispose of their whole product by sale. Evidently, then, the great majority of dairymen must look elsewhere to find means for the profitable disposition of skim-milk.

Let us then consider the manufacture of cheese as a means of utilizing the surplus. The changes in methods of creaming milk, which leave the skim-milk sweet, have, as is well known, made possible the production of both butter and cheese from the same milk. The skim-milk cheese is a well-known article. You all know that it is comparatively hard and dry, and that the absence of fat is prejudicial to the curing process; that, in short, it is much inferior to whole-milk cheese. You probably are aware, however, that it is a wholesome article of food, when properly made either with or without the addition of foreign fat. It should be placed upon the market at a price far below that of whole-milk cheese; and, as it is capable of furnishing the nitrogenous nutrients at a price far below that for which they can be obtained in meats, there should and doubtless soon would be an extensive demand for it. The introduction of foreign fat, to take the place of the butter fat which has been extracted, is, I believe, desirable. I am aware that this may seem to be dishonesty, and of course it is apparent that, like any other business, this may be dishonestly managed. It is, however, equally apparent that an article may be honestly made with the addition of clean fats, and sold for what it is, which may find a profitable sale at a reasonable price which would make it sought after by a large class of consumers.

Such cheese can be cheaply manufactured only in factories. Domestic production of skim-milk cheese can hardly be made successful and profitable. Only when large quantities of milk are handled can the maker avail himself of all the mechanical inventions which serve to lessen the labor, to improve the product, and at the same time diminish the cost of production. Already I have signified my belief in the co-operative system in dairying. Let us see if co-operative butter-making, as it is becoming established among us, is so carried on as to make factory skim-milk cheese production likely to be profitable. As most of you know, the system of co-operative butter production which to the practical exclusion of all others is becoming established among the farmers of this State, is the Cooley cream-gathering system. This system leaves the skim-milk on the farm; and it is highly improbable that, at present prices, it would pay to carry their milk to factories for manufacture into cheese. Were cheese as well as butter production in view, doubtless it would be preferable to take the new milk at once to the factory. This would involve radical changes in many respects. Such changes would involve expenses which the farmers would be loth to incur. I conclude, therefore, that with the Cooley system the conversion of skim-milk into cheese is impracticable. With the separator system, all milk being taken sweet to the factory and the cream there separated and made into butter, the case is different; and in other sections of our country are numerous factories worked upon this system, which are successfully producing both butter and cheese. The cream-gathering system is, however, firmly established here, the many so-called creameries are fairly successful, and this system is, doubtless, here to stay.

Extensive manufacture of our skim-milk into cheese, then, seems at present out of the question.

And indeed, although the actual money return from the milk may be greater when skim-milk is made into cheese than when it is fed, yet the problem *which is best* is not so simple as it might seem. When cheese is made and sold, most of the valuable elements of fertility in the milk are sent away from the farm; but if the milk is fed out, there remains considerable fertilizer value derived from it in the excrements of the animals fed. The proportion so remaining cannot be estimated at less than seventy to eighty per cent of the total plant-food elements in the skim-milk, which would make the manurial value of the residue, after feeding to animals such as pigs, equal to about seven-tenths of a cent per gallon. In other words, every gallon of skim-milk fed adds more than half a cent to the value of the manure pile; this, in the course of a year, with say a dozen good cows, would amount to the very respectable sum of fifty-six dollars. True, it might be considered preferable to get this or a larger sum in excess of the feeding value by sale or cheese-making, and to spend it for fertilizers; but yet it is important to recognize this saving in the case of feeding, in order that we may be prepared to do the system justice.

And, after all, are we not driven to conclude, that to feeding it out the majority of Massachusetts dairymen must at present look for a profitable disposition of their skim-milk? We have pointed out that but few of them can sell it; we have further noticed the difficulties in the way of cheese-making, so long as the cream-gathering system is the one pursued. Our farmers, then, must for the most part feed their skim-milk at home; and this is equally true, whether butter is made at home or cream is sent to the factory. The next question, then, is, To what animals shall it be fed? Every farmer knows the great value of sweet skim-milk in rearing young animals of any kind; and very many use considerable in rearing or fattening calves. Others use it for colts, and still others give it to their cows to drink. Any or all of these uses are of course legitimate; but in the majority of cases giving skim-milk to cows is not looked upon with much favor, and the number of calves and colts to be fed is limited. There remains a large surplus of skim-milk, which the farmer usually feeds to pigs. This I look upon as the most important farm use of this product; and my subject then resolves itself into a consideration of the most profitable methods of feeding skim-milk to pigs. Many of you have been doing this all your lives, and very likely you could teach me much upon the subject; but, in the hope that something I shall say may set you to thinking, may perchance be a hint in the right direction, I crave your attention for yet a little longer.

At the outset, in considering methods of feeding skim-milk to pigs, I desire to say a few words as to the kind of pigs to be selected; for upon the proper selection of the animals the financial result will largely depend. Nothing is better known among farmers at the present day, perhaps, than that the results of feeding vary with the animal; and yet not a few among your number exercise less care in the selection of your swine than would, I believe, pay. Without attempting to decide among all the different breeds, I propose to point out the present tendency of the popular taste, which makes itself felt in our markets, as well as the leading characteristics of each of the more common breeds of swine.

While a few years ago the demand was for a large and excessively fat hog, and while it is even yet true that our markets take many such, it is equally true that the highest prices are obtained for a younger animal, neither over-large nor over-fat. With increasing familiarity with the quality of the ham, bacon and pork from such animals, the taste and demand for them can but increase; and when it is recognized, as I hope to make clear later, that pound for pound the production of such pork costs less than the production of the large, over-fat article, the advisability of a change in practice must be evident. As a rule, you feed your pigs too long; you have animals of too slow a habit of growth, not coming to maturity early enough.

In the second place, our Massachusetts markets demand white pigs. It is indeed true that in the great pork-producing sections of the country the leading breeds are the Berkshire and the Poland-China, both breeds which are nearly all black; but, although such pigs dress fairly white, yet the carcass is not so attractive in appearance as that of a white pig, and does not sell so readily here. Excellent in almost all respects as are both these breeds, it seems nevertheless true that neither is generally popular here; and, in feeding for a Massachusetts market, neither should as a rule be selected.

Among white breeds we have a considerable number from which to select. Without any attempt to mention all, I wish to say a few words on the Yorkshires — small, middle and large — and the Chester Whites.

The small Yorkshire is probably more generally kept in the Eastern States than any other pure breed. In this breed the body is rounded, plump and symmetrical, the bones small, the legs fine and short, the head small, ears erect, nose short, and face with advancing age dished, though it may be straight when the animal is young. The disposition is quiet, and the propensity to fatten early is very strong. One of the chief objections to this as a pure breed is the small number usually produced in a litter. They also require unusual care and attention. For these reasons, although in close confinement making a good return in carcass weight for food consumed, I would not keep pure animals of this breed for profitable pork production.

The large Yorkshire is best spoken of next, and may be most easily described by comparison with the small. This is a breed less removed from the wild type than the latter, though of course vastly improved from that standard. The head is comparatively large, the ears large and drooping, the nose long, the bones and legs strong, the hind quarters often drooping, the sides flattish, and the body proportionally thinner than is that of the small breed. The growth is comparatively slow; they are seldom ready to fatten under the age of a year. They have, however, hardy constitutions, are good breeders, and the proportion of lean meat is large. Of late, by selection and improved care, the breed has acquired a more refined character and a tendency to earlier maturity. It is, however, of too slow a growth, and too coarse, as a rule (though particular strains may constitute exceptions), to serve our purpose. We want an animal which will be ready to slaughter when about six months old.

The middle Yorkshire, intermediate as it is in characteristics between the small and the large, might seem to be the animal we are seeking, and indeed this breed would serve our purpose; but the latest English authorities agree that this so-called breed has not the well-defined characteristics of either of the others. Within recent times it has doubtless been produced by a cross between large and small white breeds (probably Yorkshires); and it certainly will not pay the farmer looking for profit in feeding to give fancy prices for pure-bred animals, when, as I hope to show, he can cheaply breed precisely similar animals himself.

This now brings me to speak of the Chester Whites, probably the first breed of purely American origin. Fortunately, perhaps, for your patience, it will be unnecessary to say much; for in this breed we find the leading characteristics almost identical with those of the large Yorkshires. Especially is this true of the less highly refined families of the breed, which in point of size, form, growth, proportion of lean, breeding character, constitution, etc., seem to me to be just what the English describe their large Yorkshires to be. You are prepared to hear me say, then, that neither would I select the pure Chester Whites for profitable feeding. I desired, however, to call your attention to this breed because I believe it more than any has influenced the common stock of this State. Our common pigs are to all intents and purposes coarse Chester Whites, or, as the English would say, "large whites."

Now, excellent as is our common stock in many respects, — constitution, size, color, breeding capacity, large production of lean, etc., — it yet leaves something to be desired. The growth is too slow; the animals are not ready to slaughter early enough; the head, bones and legs are too coarse; the bodies too narrow. It is fortunate, then, that we have in our midst the very animal needed to correct these defects, and give us what we are seeking. This animal is the small Yorkshire boar, which, crossed upon our long, rangy, common white sows, will give us just what we want, — large litters of pigs, which these sows will feed well, and which in characteristics will closely resemble the middle Yorkshire of which I have spoken. Nor need this system of breeding be expensive. Already small Yorkshire boars may be bought at prices but little higher than those of our ordinary pigs; and, with increasing demand, you may be sure the supply will be forthcoming. With pigs so bred we shall have suitable stock for feeding at a profit; and with abundant skim-milk and grains at the present prices, if the profit is not realized it will, I think, be the fault of the farmer himself.

Now, as I have selected the pig and decided that the best use of skim-milk is to feed it out, you are, perhaps, expecting me to give you empirical rules for feeding him. Such is, however, very far from my intention. It is impossible for one man to give hard and fast rules for feeding another's animals. Circumstances, markets, surroundings, all influence the results to such an extent that a ration suited to A's pig may be far from the best or most profitable for B's. Such being the case, I am rather going to endeavor to make clear, first, a few of the elementary principles upon which scientific feeding depends, knowing well that, with a knowledge of principles, native business sense and shrewdness will lead most men to the most profitable application thereof. An understanding of these scientific principles, in so far as is necessary to our present purpose, will not, I believe, be found difficult; for the scientific principles which underlie the feeding of plants afford us a perfect analogy, and with these principles I doubt not most of you are familiar.

You know that, various as are the products of the soil, and numerous as are the vegetable substances — such as starch, sugar, acids, fats, albuminoids, etc. — which these products contain, yet the number of elements which are necessary to feed plants is comparatively small. Many of you know, further, that a beneficent nature supplies nearly all these elements. You know that, as the result of numberless experiments, it has been demonstrated that in the majority of cases, if we apply but three elements — nitrogen, potassium and phosphorus — in suitable forms, *proportions* and quantities, the soil is made productive, the plant is fed. Especially do I want you to keep in mind what you all very well know, — viz., that the *proportion* of these elements is important; for this has an especial bearing upon what I shall say of feeding animals. You know that you must supply to a soil, at the outset infertile, nitrogen, potash and phosphoric acid, and each in proper amount and proportion, to get a profitable crop. An excess of soluble nitrogen applied is wasted; for the crop does not need it, and the soil probably cannot hold it for the crop of another year.

The principles underlying the feeding of animals are similar. Various as are the organs and substances of the animal body, nearly all are made up of compounds which may be referred to one of four classes; viz., water, proteine (nitrogen-containing substances), fat (carbon-containing substances) and ash (phosphate of lime, etc.). These substances are either derived directly from the food or drink, or are produced from their constituents as a result of changes which take place in the body. At the expense of the food, also, the animal heat is maintained and the force for all work is generated. Some of the constituents of the food, such as starch or fat, must be burned in the body to maintain its temperature. For every stroke of work, whether of the heart, the stomach, lungs or legs, some compound of the food or body must be broken up. These substances burned or destroyed to produce warmth and work, however, fortunately for the simplicity of our subject, are still of one of two classes already mentioned, viz., proteine (albuminoids) or fat; or they may belong to a third class, represented by starch and sugar, and known as carbohydrates.

Now, two of the classes of substances mentioned as found in the body we may disregard in considering methods of feeding. These are water and ash: water because it costs nothing, and the animal's appetite is a guide as to quantity; and ash because any ordinary animal food which supplies enough proteine, fat and carbohydrates will contain mineral elements (ash) enough. We have not to think of them any more than in feeding plants we have to think of supplying iron or hydrogen. With respect to water, I must add that the proportion in the food is far from being unimportant. A food otherwise suitable may give poor results because too watery. Whey fed exclusively to pigs would be an example.

So far as the proportion of proteine, fat and carbohydrates is concerned, it would seem quite well suited to such animals; but feeding it would not give good results, because to get enough of these ingredients the animal must consume too much water.

The substances (other than ash), then, in foods which are of value for animal nutrition, may be reduced to classes similar to those found in the body; viz., proteine and fat, and one other already mentioned, — carbohydrates. To these three the name nutrients has been given. In tables giving the composition of foods you will usually find at least four columns, headed, respectively, *proteine*, *fat*, *nitrogen-free extract* and *crude fibre*. The first two you can understand; the last two both belong to the same class, — viz., *carbohydrates.*

Now, each of these three nutrients has distinct functions in the body, just as nitrogen, potash and phosphoric acid each has its distinct functions in the plant; and, just as the latter must be supplied to the plant in certain suitable proportions and quantities for the best results, so these nutrients must be given to the animal in certain proportions and amounts; and, further, just as the requirements of two plants differ, so the requirements of animals differ; and, more, the requirements of the same animal are different at different ages.

Just what the functions of the different nutrients in the body may be is not in all cases known, and it is not important for our present purpose; but much is known, and the leading points believed to be made out — mostly as the result of German work — I will briefly state. The proteine of the food may produce flesh (lean meat), fat, heat or force. The fat may be stored up in the body as such; it may produce heat, or possibly force. The carbohydrates may produce heat or fat, and, it is believed by some, force also.

Without dwelling longer upon this matter, I want to repeat that, for the most profitable feeding, it is essential to give each animal daily a certain amount of each of these nutrients. Between the different ones there must exist a certain proportion. If we give an excess of one, that excess is wasted; the ration is improperly proportioned or balanced. The most important point in the balancing of a ration is to secure the proper relation between the nitrogen-containing nutrient (proteine) and the carbon-containing nutrients (fat and carbohydrates). It is convenient to express this relation concisely, and for this purpose the term *nutritive ratio* has been adopted. The *nutritive ratio* may be defined as the ratio existing between the total digestible nitrogen-containing nutrients and the total digestible carbon-containing nutrients. For convenience, the first term of this ratio is usually reduced to unity; e. g., 1 : 4 or 1 : 3, etc.

The determination of the nutritive ratio would be a very simple matter, if all the carbon-containing nutrients were of equal value; but they are not. The digestible nitrogen-free extract and the crude fibre are regarded as of equal value; but the digestible fat is more valuable, pound for pound, than they. It is generally estimated that one part of fat is equivalent to two and one-half parts of carbohydrates. The reason is because their heat-producing capacities when burned are in that proportion. One pound of fat generates as much heat when burned as two and one-half pounds of carbohydrates. The first step, then, in the computation of the nutritive ratio, is to combine the fat and carbohydrates. My meaning will be clear from an example. Let me take skim-milk. This contains, in its dry matter: crude ash, 6.67 per cent; crude fat, 2.78 per cent; crude proteine, 34 per cent; and nitrogen-free extract, 56.55 per cent. Then fat $2.78 \times 2.5 = 6.95 +$ carbohydrates $56.55 = 63.5$ total carbohydrates. Then we have the ratio: proteine $34 : 63.5 =$ (reducing to unity by dividing by 34) $1 : 1.87$, which is the nutritive ratio of skim-milk of the stated composition. Two more expressions often heard or met with must be defined, and we shall be ready to apply the principles which I have been explaining. These are "narrow nutritive ratio" and "wide nutritive ratio." A narrow nutritive ratio is one in which the carbohydrates (expressed by the second number of the ratio) do not much exceed the proteine (expressed by the first number of the ratio); e. g., 1 : 2 or the ratio of skim-milk just computed; viz., 1 : 1.87. A wide nutritive ratio, on the other hand, is one in which the carbohydrates largely exceed the proteine; e. g., 1 : 8, or 1 : 12. The term narrow, as applied to nutritive ratios, amounts to the same as saying that the food is rich in nitrogen; the term wide is equivalent to saying that the food is comparatively poor in nitrogen.

For the convenience of those wishing to feed in the most economical manner, the Germans have prepared tables showing the proper amounts of the different nutrients for animals of different kinds and ages. These tables include what are called *feeding standards.*

The standards adopted for growing fat pigs are as follows: —

*Feeding Standards, — per Day and per Head.**

Growing Fat Pigs. Age,— Months.	Average Live Weight, in Pounds.	Total Organic Substances, in Pounds.	Nutritive (Digestible) Substances, in Pounds.		Total Nutritive Substances, in Pounds.	Nutritive Ratio.
			Proteine.	Carbohydrates and Fat.		
2–3, .	50	2.1	0.38	1.50	1.88	1 : 4
3–5, .	100	3.4	0.50	2.50	3.00	1 : 5
5–6, .	125	3.9	0.54	2.96	3.50	1 : 5.5
6–8, .	170	4.6	0.58	3.47	4.05	1 : 6
8–12, .	250	5.2	0.62	4.05	4.67	1 : 6.5

* Armsby's "Manual of Cattle-Feeding."

To use such a table intelligently, it is necessary to know the amounts of digestible proteine (or albuminoids, — these two words are both used for the same thing), carbohydrates and fat in the foods we propose to use. Such information has been published in the reports, but particularly in the sixth annual report, of the State Experiment Station. Having such tables of composition, we can easily find by a little calculation how much of certain foods will suffice to furnish the required nutrients for a given number of animals. Let me illustrate. Suppose you wish to find out what amounts of skim-milk, corn meal and gluten meal will be sufficient for ten pigs, two to three months old : —

Digestible Nutrients in One Hundred Pounds.

	Skim-milk.	Corn Meal.	Gluten Meal.
Proteine,	3.7 lbs.	8.8 lbs.	30.1 lbs.
Fat,	0.8 "	2.4 "	5.0 "
Crude fibre,	0.0 "	0.5 "	1.6 "
Nitrogen-free extract,	4.8 "	78.2 "	49.3 "

From the table of Feeding Standards we find one pig two to three months old requires daily : proteine, 0.38 pounds; and carbohydrates and fat, 1.5 pounds. Then ten pigs would require of proteine, 3.8 pounds, and of carbohydrates, 15 pounds.

By a few trials I find that these amounts will be supplied with sufficient exactness for practical purposes by the following quantities of the foods I propose to use, viz. : —

Fifty pounds skim-milk, furnishing proteine 1.8 pounds, and carbohydrates and fat 2.9 pounds; 11 pounds corn meal, furnishing proteine 0.9 pounds, and carbohydrates and fat 9.13 pounds; 4 pounds gluten meal, furnishing proteine 1.2 pounds, and carbohydrates and fat 2.56 pounds. Totals, proteine 3.9 pounds, and carbohydrates 14.6 pounds.

In this calculation the fat has been reduced to carbohydrates by multiplying by 2.5, as already explained. In the above ration the nutritive ratio is 3.9 : 14.6, which equals 1 : 3.8, which is very nearly what our table calls for.

It is not of course expected that any farmer will blindly follow such a standard. It but serves as a guide in obtaining foods containing nutrients in the proper proportions, and, to a certain extent, as to quantity. The farmer may wisely vary the amounts, but not the proportions, according to the appetites of his animals.

When with the increasing age of the pigs it becomes desirable, according to our table of feeding standards, to feed a ration with a wider nutritive ratio, it will be found easy, by diminishing slightly the proportion of gluten meal, which is very rich in proteine, and increasing the corn meal, to secure the desired result. If foods be combined in this manner, with proper attention to proportions and amounts of the nutrients, it is tolerably certain that with healthy animals there will be no waste. The ration is balanced, and the most perfect economy will be secured; just as it is when we feed our plants with nitrogen, potash and phosphoric acid, in proper proportions and amounts.

Now, the same proportions and amounts of the nutrients may be secured by the use of other feeds than those I have mentioned in my example. We might introduce bran, rye, barley or oat meal, cotton-seed meal, etc. We may secure the proper amounts of nutrients by many different combinations, just as we can supply the proper amounts of nitrogen, etc., to plants in many different fertilizers or manures; and just here lies the superiority of a feeding standard over an empirical rule. In these winter evenings you can work out amounts and proportions of feeds, as your circumstances or markets make advisable.

These German standards are the result of very many experiments, and he who shall follow them intelligently cannot go far wrong; hence I have used them for illustration. But I must now call your attention to the fact that the results of Dr. Goessmann's experiments in feeding pigs at the State Station indicate that, with American feeding-stuffs and prices, it pays better to feed pigs a ration somewhat richer in nitrogen; i. e., with a narrower nutritive ratio than the Germans advise.

For the purpose of still further illustrating my subject, I shall now call your attention to the results of one of Dr. Goessmann's experiments in feeding pigs. This experiment is described in the sixth annual report of the State Experiment Station. It is Experiment IX. of that report. In this experiment six pigs, weighing from 17 to 22 pounds, were taken. The experiment continued from April 12 to August 8, and the animals weighed alive 185 to 203.5 pounds each at its close. The feeds used were skim-milk, corn meal, gluten meal and wheat bran. The experiment was divided into four (Dr. Goessmann says practically three) feeding periods, the nutritive ratios being as follows: First period, 8 days, 1 : 2.80; second period, 34 days, 1 : 2.53; third period, 29 days, 1 : 3.63; and fourth period, 36 days, 1 : 4.35. (The first and second periods differ merely incidentally, and Dr. Goessmann in one part of his report combines them.)

The average daily ration per animal is shown in the following table: —

Average of Daily Rations (Experiment IX.).

	Corn Meal. (ounces).	Skim-milk (quarts).	Wheat Bran (ounces).	Corn and Cob Meal (ounces).	Gluten Meal (ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, .	–	3	–	6.	–	I.	1 : 2.80
April 24 to May 1, .	–	6	–	12.	–		
May 2 to May 14, .	–	6	3.47	12.	6.94	II.	1 : 2.53
May 15 to May 28, .	–	6	9.89	12.	19.78		
May 29 to June 4, .	–	6	10.67	12.	21.34		
June 5 to June 22, .	–	6	8.65	34.60	8.65	III.	1 : 3.63
June 23 to July 3, .	–	6	9.86	39.44	9.86		
July 4 to July 9, .	–	6	7.70	46.20	7.70	IV.	1 : 4.35
July 10 to July 25, .	56.10	6	9.35	–	9.35		
July 26 to August 8, .	63 00	6	10.50	–	10.50		

Observe that in this experiment, although the nutritive ratio is in all periods narrower than in the German standards, the ratio grows wider with advancing age. The assimilative capacity of the animal changes; it will not pay to give a food so rich in nitrogen (proteine) to an old as to a younger animal. Indeed, the older an animal grows, the more, as a rule, it costs to produce a pound of increase. This point is strikingly brought out by Dr. Goessmann's experiment, in which the cost of production in the different periods was as follows: —

First period, ...	1¾ to 2 cents per pound.
Second period, ...	3¾ to 4 cents per pound.
Third period, ...	4 to 4½ cents per pound.
Fourth period, ...	4½ to 5 cents per pound.

Evidently, at the same rate of increase, the cost of production would soon have exceeded the market value per pound, which in this experiment was 7¾ cents. Precisely the same tendency has been observed in feeding all animals. It pays to slaughter young. Beeves, formerly usually kept to four or five years, are now often slaughtered while yet under two. It costs much more to make a hundred pounds of increase in a steer over two years old than in one under that age. Not only is the cost of production less when animals are slaughtered young, the quality is better. How unwise, then, to feed swine until they are a year or more old, and will weigh 400 to 500 pounds. Far better from every point of view is it to promote a rapid growth from the start by suitable feeding, and to slaughter when six to seven months old. Dr. Goessmann, as the result of his experiments, advises not feeding pigs above 175 to 180 pounds, live weight. Up to this point they give a considerable profit: if fed much beyond it, loss is the result.

In the experiment of Dr. Goessmann, which we have under consideration, he figures the average net cost per pound of dressed pork at 2.98 cents; and, as the pigs were sold at 7¾ cents per pound, there was a net gain of about 4¾ cents per pound. With all due allowance for interest on investment and cost of care, there must remain a large margin of profit. An examination of Dr. Goessmann's method of calculating his result, which is certainly astonishingly good, may be of interest. He has, I believe, been criticised for allowing so much for the manurial value of the excrements of the animals used in the experiment. Let us endeavor to see whether he allows too much.

In the first place, he accurately measures or weighs every particle of food, and calculates the cost at market prices. In this experiment he allowed 1.8 cents per gallon for skim-milk. By adding the cost of all the foods, he obtains the gross cost of the total gain in dressed weight. Then from this gross cost he subtracts the value, at market prices of fertilizers, of 70 per cent of the nitrogen, potash and phosphoric acid given in the food; estimating that certainly not more than 30 per cent of these elements will become a part of the animal fed. He thus obtains the net cost of the number of pounds of dressed pork made. I have endeavored to find out whether this allowance for manurial value is fair and reasonable, in the following manner: —

The gain in live weight made by the six pigs in Dr. Goessmann's experiment is known; it amounted to about one thousand pounds. The average composition of live pig is known; the composition of the foods given is known. From these known compositions I have computed that the one thousand pounds live weight gained during the experiment must have taken of the nitrogen, potash and phosphoric acid the following proportions of the amounts given in the foods: —

Of nitrogen, less than $\frac{1}{5}$, or about 20 per cent of that in the food.
Of potash, less than $\frac{1}{30}$, or about $3\frac{3}{10}$ per cent of that in the food.
Of phosphoric acid, less than $\frac{1}{6}$, or about $16\frac{2}{3}$ per cent of that in the food.

But Dr. Goessmann allows an average of 30 per cent of each of these manurial substances to have entered into the animal. Clearly, then, he cannot be accused of making an excessively large allowance for manurial value. If the farmer does not get 70 per cent of the total nitrogen, potash and phosphoric acid of the foods in the manure, the fault must be his own, in allowing it to waste. The animal surely does not carry it away, and what of these elements he does not carry away is practically all voided in the dung and urine. The values per pound set upon the nitrogen, potash and phosphoric acid by Dr. Goessmann, are the ordinary market values of similar substances in commercial fertilizers: viz., nitrogen, $16\frac{1}{2}$ cents; potash, $4\frac{1}{4}$ cents; and phosphoric acid, 6 cents. These, if purchased, would cost these figures; so it cannot be legitimately urged, from any point of view, that Dr. Goessmann allows too much for manurial value.

In some quarters it may be further objected that Dr.

Goessmann sets too low a value on the skim-milk used, and thus figures a low cost of production. To test that point, as well as to enable you to judge whether any feed-stuff is worth what is asked for it, I desire to call your attention to a method of valuing feeds which has for some time been in use in Germany, and which has lately been worked up for this country at the Connecticut Experiment Station. This method is precisely similar in principle and utility to the method of valuing fertilizers, with which you are familiar. As a fertilizer is valuable simply for the nitrogen, potash and phosphoric acid it contains, so is a food valuable simply for the nutrients it contains. And, just as certain prices per pound are allowed for nitrogen, potash and phosphoric acid in a fertilizer, so is a certain price allowed for each pound of each of the nutrients. These prices, as worked out at the Connecticut Station, are as follows: —

Albuminoids (proteine), . . .	1.6 cents per pound.
Fat, ...	4.2 cents per pound.
Carbohydrates, ...	0.96 cents per pound.

Applying these figures to some of the common concentrated feeding-stuffs, we get the following valuation, which I have contrasted with market prices: —

	Valuation.	Selling price per ton.
Cotton-seed meal, ...	$30 37	About $26 00
Wheat bran, ...	20 22	" 17 00
Corn meal, ...	19 59	" 19 00
Gluten meal, ...	25 38	" 24 00

The valuation, you will observe, is in every instance greater than the selling price; but the amount of difference is not by any means uniform for the different feeds. Thus, corn meal sells for very nearly what the valuation shows it to be worth, while cotton-seed meal is valued at a figure considerably above its selling price. It will evidently pay to buy the latter in preference to the former, whenever it will answer to use it. It is the cheaper feed of the two.

In order to apply the figures for albuminoids, fat and carbohydrates to skim-milk, for the purpose of testing Dr. Goessmann's valuation of that article, we must in the first place make some allowance for its superior digestibility. The nutrients in skim-milk are entirely digestible, while in cotton-seed, corn meal and similar feeds they are not all digestible. On the average, in such feeds about one-seventh of the albuminoids, one-fourth of the fat, and one-eleventh of the carbohydrates, are indigestible. A pound of albuminoids in skim-milk, then, should be worth 1.87 cents; a pound of fat, 5.6 cents.; and a pound of carbohydrates, 1.05 cents. The value per 100 pounds of skim-milk would then stand as follows: —

3.7 pounds of albuminoids, ...	6.9 cents.
0.8 pounds of fat, ...	4.48 cents.
4.8 pounds of carbohydrates, ...	5.04 cents.
Total valuation of 100 pounds of skim-milk,	16.42 cents.

If we estimate a gallon to weigh nine pounds, we shall then have a valuation of 1.6 cents per gallon, which is a little below Dr. Goessmann's valuation of 1.8 cents per gallon. We see, then, that, as compared with other feeds on the basis of valuation of the nutrients, Dr. Goessmann's figure for skim-milk is high rather than otherwise. I do not see, then, that his results, which are wonderfully good, can be assailed on any side. He estimates purchased feeds at market prices; he allows too little rather than otherwise for the manurial value of the excrements; he estimates the skim-milk at a fair figure; and yet he makes a net profit of four and three-quarters cents per pound on the cost of production, to pay for care and interest on investment. Farmers, can you do as well? I believe you can, if you heed the lessons which I have sought to impress upon you; if you follow the advice of the learned doctor.

Select suitable animals, feed at first a rich food with a narrow nutritive ratio, make the food less rich (widen the ratio) from time to time as the animals grow, and finally slaughter before the animals reach the live weight of 200 pounds. As to foods for combining with the skim-milk, you have a considerable range of choice. Select those the valuation of which exceeds largely the selling price, in so far as may be possible. With the observance of these rules, you can hardly fail, with the exercise of good judgment, intelligence and proper care, in obtaining satisfactory results.

One more point brought out by Dr. Goessmann's experiments I wish to speak of, and I am done. This is the effect of season upon the cost of production. The doctor has carried out two experiments, alike in all other essentials, but differing in the season. One experiment was carried on from November 8 to March 12, and in this the net cost of production of one pound of pork was 3.83 cents. The other experiment extended from April 12 to August 8, and in this the net cost of a pound of pork was 2.98 cents. Here is a difference of .85 cents per pound in favor of summer feeding. In each of these experiments the total gain of the six pigs amounted to about one thousand pounds. The total advantage in favor of summer feeding amounted, then, to $8.50 on the six pigs. This sum at present prices would buy about a ton and a half of coal, and this amount of coal would be sufficient to keep a well-constructed room, fifteen feet square, at a comfortable living temperature all winter. It would not require to be quite so warm for pigs; and it cannot be doubted that a pen sufficiently large for six animals could be kept warm enough to keep them gaining even faster than in summer, — for there would be no flies nor excessively hot days, — with a consumption of considerably less than a ton and a half of coal. I suggest, therefore, that the question whether to keep animals warm by burning coal is not more profitable than to do it by giving an excess of food, is at least worthy of experiment. But, whether you warm your piggeries or not, you should at least draw one or two lessons from this result. It will pay to fatten animals in warm weather, rather than in winter; and it will pay to feed them in well-constructed and warm buildings. Warmth must not, however, be obtained at the expense of ventilation and pure air. Disease will certainly follow overcrowding in ill-ventilated pens. Warmth and pure air are the essentials for health, rapid gains and profitable results.

Mr. J. W. Stockwell of Sutton. Before taking up the discussion of the subjects which have been so admirably presented to us in the addresses of the morning, I desire to introduce, and move the adoption of, the following resolution: —

Resolved, That the Massachusetts Board of Agriculture, reaffirming its resolutions of last year, does pledge itself anew to use its best endeavor to obtain legislation that shall suppress and punish fraud in all dairy products, and also to advance the interests of this important branch of agriculture to the farmers of this State.

Mr. HICKOX seconded the resolution, and it was adopted unanimously.

Mr. GRINNELL of Greenfield. Perhaps there will be no better time for a resolution which I desire to offer than the present; so I move the adoption of the following: —

Resolved, That the State Board of Agriculture, in signifying their great satisfaction with the arrangements and proceedings of this winter meeting, desire to express their thanks for courtesies and attentions extended to them by the city government and the citizens of Fitchburg.

The resolution was seconded, and unanimously adopted.

Mr. STOCKWELL. As I listened to the address of Secretary Gilbert, I noticed that the credit of introducing co-operative cheese-making was given to a different person from the one to whom I had always credited it. In looking up this matter some few years ago, I thought I found that Jesse Williams of Rome, Oneida County, New York, was the originator of the cheese factory. It was brought about by the sickness of his wife, he being obliged to take her place in making cheese; and he produced so fine a product that a demand was at once created, the price advanced, and the desire for more became so great that he joined with his farm that of his son, and together they supplied the product for a time, and then others of their neighbors were brought in. I took this from an English authority, by an American correspondent, found in the office of the Secretary of our Board of Agriculture. Growing out of this, Cornelius Schemmerhorn of New York State was called to England, and there took charge of the first English factory that was ever introduced, I think in Derby. The introduction of co-operative cheese-making and co-operative creameries led to the introduction of American cheese into England; and that was the beginning of the exportation of American dairy products. It began in 1850, and at the present time it is millions of pounds. I simply wanted to call the attention of Secretary

Gilbert to this fact, that I may be corrected if I am wrong.

Mr. Gilbert. I think I did not allude to Mr. Willard as being the originator of the associated system of making cheese, but as having been one of the first to call it to the attention of the public in our country. However, since the gentleman has called me up, I wish to call his history a little in question. I think the honor of first introducing, or first inventing, if you will allow the word, the associated system of cheese-making, does not belong to Jesse Williams, but to another. The name has now gone from me.

Mr. A. W. Cheever. In the report of the Connecticut Board of Agriculture for 1888 you will find that the first pineapple cheese in this country was made in 1808, by Lewis M. Norton of Goshen, Conn. He continued making this cheese, from his own dairy of less than fifty cows, from 1808 until 1844, when he commenced buying curd from other dairies, and built, as we suppose, the first cheese factory in our country. The manufacture of pineapple cheese has been continued on this place in Goshen since 1808.

Mr. Gilbert. I was going to say it belonged, not to New York, but to the nutmeg State, as so many other good things do.

Mr. A. H. Fitch, Secretary of Milk Producers' Union. The resolution which has been adopted here brings to mind the fact that the legislation of the last five or six years in regard to milk has made a difference of $600,000 to the inhabitants of Boston and the towns within five miles of it. If you turn to the report of the Inspector of Milk, you will find that sixty-three samples out of a hundred were found to be adulterated in 1883, and in 1889 only five samples. That change has been brought about by the enforcement of the adulteration laws. This has increased the confidence of people in the quality of the milk to such an extent that the amount per person sold in Boston and its environs has increased more than fifty per cent in the last seven years. This is to the advantage of the producer.

Again, Boston has got its milk for a less price, according to the inspector's report. In the last five years the improvement in the quality of milk has been very nearly one-seventh, and the consumer gets as much of solids in the milk for seven cents as he got for eight cents before. It has been said that he who makes two blades of grass grow where one grew before is a benefactor of mankind. We are now able to make a little more milk and a little more butter from each cow. The attempts of the farmers in the past three years to have something to say regarding the sale of their milk, and not have the dealers alone set the price, have increased the price to the producer over six per cent in the past three years. Does it pay?

Adjourned to one o'clock.

Afternoon Session.

The meeting was called to order at one o'clock, by Mr. Cruickshanks.

The Chairman. The lecture due at this time is upon the subject, "How to Make Poultry-keeping Profitable," by Dr. G. M. Twitchell of Fairfield, Me., associate editor of "The Maine Farmer," whom I have now the pleasure of introducing to you.

HOW TO MAKE POULTRY-KEEPING PROFITABLE.

BY DR. G. M. TWITCHELL OF FAIRFIELD, ME.

The day has arrived when, in measuring any industry, the standard of dollars and cents must determine value. If this be thought too much of a utilitarian view, the answer must be that every surrounding influence, every possible condition entering in, forces to this one standard by which results may be accurately measured.

The trees in our orchards, beautiful, symmetrical and attractive, are valuable as orchards in proportion as they throw out on bough and twig the blossoms of May and the rich fruit of September. The dairy cow on which we are coming to depend so completely, is of service to just the extent that she produces the golden, waxy product in excess of cost of keeping. The sheep must be measured, not by fancy tastes or desires, but by the wool and mutton product. The horses, multiplying so rapidly all over New England, are to be increased or diminished just in the ratio of their conformity to this one standard of merit. By their fruits all these must be measured. The hogs, working upon the manure piles, are being perfected with the one thought of making pork at a profit, even though the price received be low. The farmer's income must come from the productions of the farm, and there is to-day no escape from a study of the worth and cost of production.

How can poultry-keeping be made profitable? By the application of the same laws as govern elsewhere, — by *knowing* that the cost of production is below the price received.

Symmetrical trees, fine-limbed and beautiful Jerseys, large and well-proportioned sheep, pedigree in hogs, beauty and blood in horses, and perfection of markings in poultry, all these must give way to *business*, in agriculture. No man places a higher estimate on these points than I; but there is a higher test, a great, controlling question of profit or loss; and to the individual farmer, struggling in the current, battling against the sharp competition of to-day, this is the question calling for solution. It is this one supreme test which will bring out the true metal and gladden our ears with its merry ring.

I want to-day to weigh and measure what I have to say in the scales and measures of the farmer, dependent on his lands, flocks and herds for his support. The fancier can pursue any path he chooses, but with the great majority the question of bread and butter is uppermost. Therefore, while as a breeder recognizing all that can be claimed for blood, color or markings, I would bring another standard, and measure the poultry industry in the light of possible profits for the breeder looking entirely to the open market for the sale of his poultry and eggs.

For present excellence we are indebted to the specialists who have probed to the very centre the problem of life and its wonderful powers of transmission. No stronger proof of the good work they have accomplished can anywhere be found, than may be seen in the poultry yards. I present this thought first, because it is absolutely necessary that we realize the steps leading to present standards, else we shall surely fail of maintaining our position.

The magnificent specimen seen to-day, weighing eight to ten pounds, or producing twelve to thirteen dozen eggs yearly, is not an accident. She has been evolved out of the brain and hand of man, through centuries of breeding. Place before the mind's eye a selected representative of any breed, and then try and imagine what was the type when only the wild bird existed, and through what stages of development the flocks have been rising since man was given dominion over the beasts of the fields and fowls of the air. Left to their native state, the product would be only what was necessary to perpetuate the species, as seen in the quail and partridge; but *man* — restless, unsatisfied, aspiring man — began the work of subjugation. There came to him, in the caves and fields, dim visions of what might be; and he began building upon this foundation, and through the ages has labored patiently and persistently, until we have entered into all the fruits of the past. Why, the horse, cow, sheep or hen of to-day is a monstrosity, when viewed in the light of even fifty years ago.

No man breeding for possible profit can realize the most unless he seeks continually to come into a knowledge of the growth of the centuries. Present standards are not fixed. The law of reversion is underneath; and, unless we put ourselves into the work, and by steady application seek to advance, there is sure to come a falling away from the full measure of what otherwise might be ours. Hence the claim is made that here is the corner-stone upon which we must build, and *every* breeder must come into a knowledge of the principles involved. The great law of compensation permeates everything, and in the poultry yard we receive in proportion as we give. The large per cent of profit possible to the breeder is contingent upon a knowledge and observance of certain conditions, the first being this one of heredity. Success is not an accident; and to you engaged in poultry breeding, I want to present this one underlying thought as of supreme importance. Know the steps leading to present standards, and patiently labor to improve. Observing these in all their details, it is possible for any breeder to realize, from every hen kept, a net profit yearly of two dollars per head, at prices realized in the market during the current year. To substantiate this, let us consider first the egg question.

I venture this, that not one in one hundred can give any adequate idea of the cost of keeping. The necessity for the itemized account is not appreciated. It must be resorted to in order for success to follow. Pencil and paper are the first requisites for the practical poultry keeper.

Towering far above the question of breeds is that of care and feeding. Our breeds are what we make them. They adapt themselves to their environments, and partake in a marked degree of the traits and characteristics of their owners. You have in Massachusetts a host of breeders who have stamped their own individuality upon their breeds. Any man acquainted with Light Brahmas could select a Felch, Williams or Comey bird, if seen in California, before it had adapted itself to its new surroundings. So long as the controlling influence of these breeders was upon them they told the story. To-day may be seen specimens of Drake Plymouth Rocks, though he who fixed the type has long been at rest. So I might run through the list and name scores of breeders; but this will suffice as an illustration of my thought.

Judged by the standards of the market for poultry and eggs, discarding the so-called fancy issue, these men have realized great things from their poultry yards. I do not doubt Mr. Felch has secured two hundred eggs yearly from individual Light Brahmas; for no man can dream of the possibilities of this industry until he buries himself in the work, and with cautious steps looks carefully after all details. The average of production is with the breeder, though the hens produce the eggs. That is, the development of eggs is dependent entirely upon the food question. What is an egg? It is an ounce and a half of concentrated food, made up of lime, soda, sulphur, iron, phosphorus, magnesia, oil and albumen. The hen is the mill to grind, the crop the hopper, and the egg the grist. Feed the hopper, and the grist will be forthcoming. I am aware that this is a very business-like view; but I am measuring the hen as a machine, aiming to make clear the claim for profit in poultry breeding. The great want everywhere is an appreciation of the laws of feeding, and the digestibility and assimilation of food. Every particle of the egg — yolk, albumen and shell — must come from the assimilated food through the blood cells. It is a wonderful machine of which we are speaking, capable of taking the grains, grasses, vegetables and fruits; grinding in the marvelously constructed machine, the gizzard; then dissolving, separating and distributing to the several parts the energies necessary to sustain the body, and storing material for making the product desired, — eggs. We cannot feed concentrated egg-food, for no man can produce it; but we can feed the elements in the very best manner possible, prepared in the alchemy of God's providence, by a Divine Chemist; and, when fed in accordance with an intelligent plan, force the production of what is wanted.

Under the breeding of the past twenty years the organs of reproduction have been stimulated to a fury; and now it is necessary that we pause and measure the steps, in order that there be no loss in the future. If we feed corn, or other fat and heat-forming food, there cannot follow the largest production of eggs, because the material for eggs is not in the corn. The tendency will be to turn the current in the direction of fat accumulation. Corn contains eighty-six per cent of heat and fat elements. The value of any article of food is not the cost per hundred pounds, but its power to produce what is wanted. The cheapest article of food for egg-making is that which will produce an egg at the least expense. There must be a turning from the habits of former years, and a study of this question with sole reference to cost of production.

The expense of keeping a hen varies from one and one-half mills daily to five mills. At present prices of grain, it is both possible and practical to keep our flocks in perfect health, and so in the highest state of productiveness, at a daily cost of two mills per head. We shall be the better prepared to do this as we study the food question, and in variety and quantity meet the needs of the system, supplying the food elements from most inexpensive sources, and balancing these for egg production. It cannot be the quantity taken, but that which is completely digested and assimilated. If there be any excess, the energies which would go to the making of eggs are consumed in the vain attempt to take care of and expel all surplus. Thus food consumes food. To a certain limit, we may force the storage of albuminous food; but if that limit be passed, there results a weakened condition of liver and kidneys, which rapidly develops into disease. There must be a perfect egg ration, one that will keep the animal in health, and produce the desired product. How, then, shall we feed? Good second-crop clover contains lime for shell material, and albuminoids for flesh and muscle forming in excess of corn, and is equal to wheat as a nitrogenous food. Here, then, is a valuable food, not expensive. Oats, wheat, bran, chopped hay and vegetables, with meat scraps, must form the bulk of food for eggs, with corn as our sheet-anchor for fuel to supply animal heat or produce fat. In my own experience, I found a mixed ration most profitable. I mixed together twenty-five per cent of oats, wheat and bran, ten each of corn and linseed, grinding all together, and then adding five per cent of meat scraps. Cooking vegetables, or steaming chopped hay daily, and adding just enough of this mixed grain to give consistency to the mass,— say three quarts to the bucketful,— and allowing the whole to cook all night in a covered tank, I have secured a ration satisfactory, yet not expensive. To-day I would rely more largely upon clover. For whole grain I have always been governed by circumstances, finding the best results when I reduced the corn ration, save in extremely cold weather, when it must be our chief dependence, because of its heat-giving elements.

There is no way of determining the exact quantity to be fed a hen, because of the infinite variety of temperaments and habits, created and intensified by years of breeding, warmth of buildings, and want of regularity in attention. It cost as much to keep an active Leghorn as a sluggish Plymouth Rock. Size cannot be a fixed guide to quantity. Rations, as published, can only approximate. If the whole thing were settled, we could perfect a machine to do the entire work, and save ourselves much worry and labor. The fact is, these enormous profits come only in return for something given.

The normal crop of a hen will hold but a small quantity. Distend it by inviting the bird to eat appetizing food, and four times the amount necessary for health will be taken.

We have all seen this, when feeding corn at night; how each bird will crane its neck, trying to force down the kernels, and satisfy the palate. The idea that an animal will eat only what it needs, is one of the beliefs we should disabuse ourselves of as quickly as possible. Every breeder must be a law to himself, seeking always to measure the needs of individuals, and to supply the smallest quantity consistent with best health and productiveness. Here is the economy of feeding, the value of balanced rations. It is not niggardliness, but true liberality; for it seeks, first of all, perfect health, by balancing the condition of the animal. Nature's method is a grain at a time, and a constant searching and scratching for these. Our system too often is to crowd the food into the crop in the shortest possible time. If the nerve energies resulting from the tissue foods be consumed in removing, grinding, digesting and assimilating food, they cannot produce eggs. Each body is capable of expending so much force daily. If the ration be balanced all is harmony, and the natural functions are carried on smoothly. By the observance of these principles the flocks have slowly yet surely been graded up to present high standards. To-day no man can dream of the possibilities of the future, provided the highest skill is exercised in the selection and balancing of rations.

Aiming at a solution of the problem of profitable poultry culture, the selection of breeds must receive attention. No man can succeed in an undertaking unless he has a natural inclination for it. Especially is this true in poultry breeding. Not only must he be an enthusiast, but the variety must be what his fancy dictates. One man, with a love for the majestic Brahmas, will realize many times as much as his neighbor, who attempts their culture because somebody else succeeds. Or another, full of admiration for the active Leghorn, will score a grand success, after utterly failing with other varieties. Success hinges largely on natural adaptation to the work. For want of this, there is no upward striving, no reaching forward to a higher standard. While the term Brahma or Leghorn has a certain meaning, it by no means follows that the individual of either breed excels in all characteristics. Remembering what has already been said in relation to the origin of breeds, we must get back of the bird, and learn the controlling spirit of the breeder, before we can measure accurately. A Brahma may be such in all purity, and still be almost a cipher in all points of excellence; and a Leghorn may have all the outward marks of the variety, and be wanting entirely in the power to produce the luscious fruit of the hen-house. If these premises are correct, it follows that the fancy, the ideal of excellence in the individual breeder, has more to do with success, than the breed, and that any variety may be transformed to meet the requirements of the breeder. Here is the explanation why one family of Brahmas excels as egg-producers, while another towers far above as poultry.

It was this spirit of unrest, this desire to realize more than had been secured, this belief in the possibility of reaching something better, combining in a still more marked degree the essentials of all breeds, that first led to the crosses resulting in the Plymouth Rocks, — a breed that to-day, throughout the country, ranks second to none. The same spirit has since developed the Wyandottes, like the Plymouth Rocks in general characteristics, save color. These two varieties are proof positive of the fact that our poultry is in our hands to be molded, changed, corrected, enlarged, and built upon according to our desires.

By the application of the same principle, weeding out the inferior ones, breeding only from the best, and feeding for a specific purpose, I believe it possible in the near future to reach an average of thirteen dozen eggs yearly, with small flocks. The fact that individuals do this, or more, justifies the claim that others will, when bred, fed and cared for in the same manner. This can never come through indiscriminate breeding from any flock, no matter how high the average. There is always a choice, and eggs for hatching should come from the hen, or those hens, who excel in form and size, or as layers. To-day there is wanted a broad body, deep and compact, not long in the legs or neck, with legs well apart, in color bright yellow. Such a bird would give the greatest weight with least waste. For such, a higher price will be paid by the purchaser.

In some sections there is a demand for colored eggs; but

I fancy the breeder of Spanish classes will realize as much for the white ones if they are as carefully selected, and free from stains. The difference in quality of eggs is not in color of shell, but in the food supply from which they are constructed. Flavors come from the food in eggs, as well as milk.

In selecting breeding stock, be assured the hens are not an accident, but have been bred for generations from stock possessing positive virtues. Let the breeding be to fix the predisposition of heredity. Increased size, early maturity, desired form and greatest production will in this way be secured, an upward tendency being all the while maintained.

I have not urged pure-bred stock, because I am here to enforce, if I may, the one lesson of possible profits for the farmer, and not to speak for the specialists; but it must not be construed that mixed grades of any and all breeds are to be brought together, for this can never satisfy. Each breed represents a peculiar idea; each has its own individual characteristics, and excels in some particular.

For the average farmer or mechanic, wanting eggs and poultry, and without time to study the problem of breeding, and cultivate and improve on the work of the specialist, high grades will give better results than pure-bloods. It is easier to improve with grade hens of one variety, and a pure-bred male, than to hold an even keel with pure-blood stock. Never use a grade male. There can be no uniformity, no satisfaction. Secure, yearly, a male pure in breeding, rich in inheritance, strong and healthy; and, making use of the best hens, there will surely come a steady advance in the type and productiveness of the flocks. Avoid all violent outcrosses. Use a male of one variety, and so reach after and secure the highest possible profit. It is business in the poultry yard we are discussing to-day, — business for the farmer with his many cares, for the tradesman or mechanic having only limited time; and for these reasons I urge high grades. There is money in the business of breeding pure-bloods, but more time and attention are necessary, a more critical study of the tastes and requirements of other breeders is demanded; and, because of this, the great majority of farmers who keep hens solely for profit, cannot do more than give a fair amount of attention to the all-important questions upon which the industry rests, and must leave the field of fancy stock to the fanciers.

It is idle for any one to think of adding poultry breeding to the round of daily duties, without subtracting the equivalent from other cares. Farm work is exacting. Nothing can be neglected, neither can the farmer divide his attention among too many departments without loss. Better by far confine to one or two lines, and in these seek to excel. No man can succeed in poultry culture, who feeds and waters once a day, cleans out the pens when it rains, collects the eggs after dark, and breeds with no special reference to quality. These are the men who fail in everything. They are the ones who in public, and through the press, declare that the business is a humbug; that every egg costs a dime, and a pound of poultry is worth a dollar to the grower. This to them is the truth, simply and only because they reach out after and attempt to grasp every branch known to agriculture, and neglect the conditions underlying success. A daily round of little duties makes up the sum total of the labors of the poultry man; and not one of these can be neglected without loss.

The average price received by the breeders in central Maine this year for eggs will be a fraction less than twenty cents a dozen. Those of you who have put yourselves into the business, and made a market for choice stock, have realized thirty cents or more. Why is it that all the farmers do not secure this higher price? The demand is active, the supply limited. It must be because they fail to observe the conditions. With the fact staring us in the face, that the market is ready to pay thirty cents a dozen for selected eggs, absolutely fresh, from stock fed on sound, healthy grain, the great majority, through neglect, fail to secure or ship their product in quantity or quality sufficient to secure more than the average market price. If we but meet market requirements, we might from the sale of eggs realize the full measure of profit claimed at the commencement of this paper. An average production of ten dozen — not large — would insure a gross income of three dollars per head. With cost of production reduced by a study of rations, the expense of keeping would not exceed seventy-three cents per head, leaving a net income of two dollars and twenty-seven cents.

But there is another field claiming our attention, — that of growing poultry. To-day an exacting market meets the producer. The great West is pouring in a torrent of meat product, grown at less cost than we can possibly hope to secure. The only hope for New England is in the production of a better article, and the placing of the same on the market in choice condition. One advantage is ours, — distance cannot be annihilated. We have from thirty to forty hours advantage, and to improve all this conveys, is our opportunity. Quality, then, must determine price. To secure this, we must begin at the same foundation as when looking for eggs, — the parent stock. While we may possess an all-purpose hen, or variety capable of producing a goodly number of eggs, and yet valuable as poultry, it is a fact that this combination detracts from the highest excellence in either direction. A variety bred solely for eggs, will, if the work be carried forward systematically for a series of years, not only excel in this respect, but take on a form peculiarly adapted to egg production. The wonderful elasticity of Nature's laws is surprising; and, whenever men attempt an improvement, unseen forces seem to co-operate to secure a type best fitted for the object desired. If the egg-forming habit be cultivated and stimulated, the tendency will soon become fixed in the breed; and for this reason, if for no other, that variety cannot excel as meat-producers.

Again, the breeder who seeks for the very best poultry will breed from those birds possessing the greatest merit in this one direction; form, color of leg and flesh, and rapidity of growth, being the essentials sought after. Doing this, egg production becomes secondary, and the tendency is towards fixedness in flesh forming. In combining the two, there must be a dropping from the highest standard in either. While some breeds possess ability to produce both in a marked degree, as seen in the Plymouth Rocks, Wyandottes and some families of Brahmas, it is useless to expect to equal the standard of him who bends all his energies in one direction.

Success, then, in growing poultry for the market, depends upon the selection of birds bred for market purposes, and mated to produce their superiors. The great cry is for early maturity. Broilers at ten to twelve weeks, roasters at fourteen to sixteen, — here is the line of profit, and to crowd the most growth into the shortest possible time is the secret of successful poultry growing. The highest price goes to him who in twelve weeks brings forward the plumpest body, best proportioned, and with the largest per cent of flesh, most attractive in color. Breeding only from those excelling in these qualities, and feeding for this one end, the story is soon told to the satisfaction of the breeder. The food for making bone, muscle and flesh in the chick, is very much the same as that for producing eggs in the adult fowl. Begin at the first to feed strengthening food, tissue food, leaving the fats to be supplied later. Milk here enters in as one of the most valuable products; and by milk I mean that which has had the fats removed for churning, for this is far better than the whole product. Testing the eggs after being under the hens, or in the incubators, seven to ten days, and removing those not fertilized, we have the very best food for little chicks. Not only is valuable time saved by removing the infertile eggs, but by cooking these thoroughly, and mixing with bread or cracker crumbs soaked in milk, an excellent food is provided at slight expense. The crop of a chicken is a little thing, and should not receive more than half a tea-spoonful at a time. A slight excess will destroy life or retard growth, and for the most rapid work there can be no faltering for an instant. After the third day, green food should be given. If the flocks have access to fresh grass, this will be unnecessary; but it does not do to wait for the buds of spring before starting the broods. They should begin to appear next month, — January, — and be on the market before spring fairly opens. Sow rape or oats in boxes, and cut when two or three inches high, chopping fine, and feeding daily. For animal food, I have found meal worms extremely valuable, yet inexpensive. These I have grown in flannel or lint, kept in a warm place, sprinkled with meal, and wet with sweetened water. Later it has been my custom to use the wastes from the butcher shops, exposing until tainted, then sprinkling with meal and covering with moist, warm earth.

Continue the skimmed milk as long as possible. In no place can this valuable product be made to pay better returns than in the poultry yard. In cooked food, never feed anything sloppy. A dry, crumbly mass is best. In using milk for mature stock, we must remember that it is food, and its value must be taken from the other supply, else troubles will appear. For growing chicks, the best ration I have found has been composed of thirty per cent each of oats and wheat, twenty of corn, ten of linseed and ten of meat scraps. This, mixed into a dough with skimmed milk, I would bake until thoroughly cooked, set away at least twenty-four hours, and then pound or grind, adding more milk if I desired to feed as dough, or giving dry. In this combination I consider linseed one of the most valuable parts, but would never feed more than ten per cent. It is rich, albuminous food, and hence valuable in forcing growth. If these chicks were to furnish my future layers, then surely the ration must be changed to meet the different conditions.

Having the ration fixed as regards variety and quantity,— this last being a very important item,— there enters at once another factor that must be considered,— regularity in feeding. No matter how choice the stock, how careful the breeding, how well-balanced the ration, unless regularity be observed in feeding, it is utterly useless to expect to succeed. Hunger must be appeased at once, or the system draws upon its own stores for nutriment. If regular hours are observed, Nature adapts the animal to the condition ; but the practice must be maintained. A little at a time, and that often, will insure the most rapid growth. Feeding in this way, forcing growth by selected rations, large size will be secured at an early period. Early maturity in everything must be our motto. The chicken put on the market at twelve weeks, to weigh two pounds, will have cost for food not more than eight cents a pound. As broilers sell readily for thirty cents a pound, or more, until the first of June, it pays to grow them. Rather it pays to give a return of extra care and labor, for this growth comes as compensation for what we give.

In growing to maturity, and marketing when four to four and one-half months old, the dressed weight should be at least five pounds, at a cost for food materials of thirty to thirty-five cents, or seven cents a pound. These figures are on the assumption that a certain amount of liberty is given the chicks daily. In growing these maturer birds, the fattening process should be reserved for the last twelve or fourteen days. It is bone, muscle, flesh, that is needed,—bones strong in substance, large in size; muscles capable of carrying the frame to full maturity, and flesh of healthy structure. There is no room for puny constitutions. When the time approaches for marketing, confine in dry pens, with only light enough to enable the bird to find its food. Here, as all the while, regularity is to be observed; but the ration now wanted is to be rich in the fats, starches and sugars; and we turn to the corn, buckwheat, barley, an increase of linseed, sunflower seeds, and enough cooked vegetables to aid digestion. Now we enter upon the cramming process, when fats are to form rapidly, and the bird pushed on to the market just before the breaking down of the tissues. As much as possible of the entire ration should be cooked, in order that the work of digestion be aided as far as we may. Feed whole corn at night, removing all that is not eaten. In the time specified, from twenty to thirty per cent will be added to the net weight, at comparatively little cost. Such poultry satisfies the epicure. It is rich, juicy and tender, more so than would be possible if allowed its liberty and its muscles and flesh strengthened by exercise. When ready to ship, give no food for twelve hours, that the crop and intestines may be empty, or at least that all food may have, in the process of digestion, passed the period of fermentation.

When ready to dress, suspend the bird by a cord about the legs, and, holding the lower mandible firmly with the left hand, pass the sharp blade into the roof of the mouth, where by a quick cross movement you sever the arteries, and the vertebræ at the base of the brain. A convulsive spasm tells the story, and, before this ceases, the quill feathers should be pulled. If the work be done promptly and rapidly, the whole surface will be cleared in a very brief time; whereas, by a little neglect, the labor will be many times increased. Open and draw, making as small an incision as possible; remove the head, roll back the skin on the neck, and draw out the crop; then draw the skin over the neck, and tie neatly. When thoroughly cooled, pack in clean boxes, and never put in a bird that is marred in the least, or off color in skin. The appearance of the package when opened will have much to do with the price, and the presence of a single inferior specimen will fix the price for the whole. Dressing and shipping a superior article, the market will always be open to receive it, at prices satisfactory to the grower.

Either line of operations calls for the exercise of the highest skill, patience and ingenuity. Again I say, which you adopt will depend upon your individual fancy. In combining, two distinct ideals of perfection must be kept in view, and the object aimed at never for a moment forgotten.

When growing chicks, intending the pullets for layers, separate at an early age, and give the pullets a freer range and coarser food. Grow strong, hardy constitutions. Be sure to avoid producing fat. Bring them to laying, in simply good growing condition. A pullet that is fat will not commence laying at so early an age, neither will the process of egg-forming be continued as regularly, as though the ovarian system were not crowded upon by the fats of the body. We are aiming at two hundred eggs yearly as the average of our flocks. If it ever comes, it will be by growing our pullets for layers, giving them hardy constitutions, keeping them in condition for egg producing, and providing rations adapted to the work desired. Whether it be true or not that the germ of every egg is formed before the first goes to the egg basket, this much is true, — that, if we dress a pullet just as she comes to laying, we shall find an egg developed, and others in varying size, until we have counted perhaps three hundred and fifty yolks. Back of these is what seems a mass of membrane; but bring hither the microscope, and it tells a new story. This is simply an aggregation of minute vesicles, infinitesimal yolks. Count these, and we have about three hundred more. For our present purpose, it makes no difference whether these are all there are to be formed, or not. The point is here: these germs are to be developed by and out of the food supply taken into the system, digested and assimilated, treated in that wonderful machine, — the stomach, freed by acids and dissolved by alkalies, and finally carried in solution to the ovary, where eggs are to be matured. The secret of the industry, if there be one, lies in the ability to force the development of these germs, by feeding rations balanced for egg production.

Only by the appreciation of this principle can we maintain the production of to-day. Instead of being five years or more, these germs must be matured and on the market in two and a half or three. Why, gentlemen, we shall not rest until we have a machine capable of yielding an egg every twenty-four hours, and then some live Yankee will go to work and attempt to double the product.

One more claim must be made for this systematic feeding. In no other way can we secure eggs for hatching that will develop and send out healthy chicks. There must be hardy constitutions in sire and dam, in order for hardy offspring. There must be virile energy in both, in order for living chicks to be secured. As the albumen of the egg contains practically all the elements out of which the chicken's body is made, and the yolk only serves to strengthen the last few hours before, and first few after, leaving the shell, it follows that this albumen must be rich in bone, muscle and flesh elements.

Again are we driven back to consider what was the condition of the parent stock when that egg was being formed. Was the hen closely confined, and fed largely on corn, or was she given abundant exercise and nitrogenous food? The whole question hinges right here, and here is where the great majority fail. They bring their pullets to winter quarters after a season's run with the cockerels, the food having been such as would put the latter in marketable condition. It is no wonder eggs are not forthcoming, though the comb reddens, and the musical sound is heard. Confine these birds in warm, sunny pens, feed liberally on food easily digested, and then expect eggs that will hatch. Why, the whole line of operations has been to defeat this very end. A moment's reflection will convince that it is utterly impossible to expect returns under such treatment. Here may be found an explanation why one failing with Plymouth Rocks succeeds with Leghorns, because of the natural habits of activity in the latter. Not that he succeeds in securing the most financially, but in keeping his flock alive through the winter, — something impossible with larger breeds, when liberally fed and kept from exercise.

Thus far the attempt has been made to present the question of breeding for profit, and to show, if possible, on what basis the industry rests, and how the claims made may be substantiated. There remains another question to be answered. Will the poultry industry pay the average farmer, and what is the cost of commencing operations? After an experience of more than twenty years I can answer the first part of the query decidedly in the affirmative, measuring the business by market standards. It has paid me just in proportion as I have observed the conditions urged in this paper. Year after year I have realized a net profit of two dollars per head; yet to-day I can look back and see how I failed to appreciate the significance of the lessons I have presented for your consideration and discussion. There is more in store than we have yet attained to. In all operations, one must learn to walk before he runs the race, and small beginnings lead to great results. This is a business having to do entirely with cents and fractions of cents.

A building to accommodate fifty hens can be built for from twenty to thirty dollars. Expensive structures are not necessary. Such a building would be 20 by 12, with seven-foot posts; sills, 4 by 4; studding, 2 by 3; boarded and shingled, the walls covered with tarred paper or battened, and paper used inside; two windows on the south, twelve lights, each 8 by 10; door at the end; with roosts two feet from floor, across opposite end; and flooring six inches below, to catch droppings. Add nests and drinking dishes, and the house is ready for the hens. In building such a hen-house, select a dry, gravelly knoll, haul on small stone to the depth of ten inches, and set the sills on these; then fill to the top with dry earth. You have thus secured perfect drainage and the best dust bath possible. I know this is not a beautiful structure, but it is comfortable, and by our measure to-day will suffice. On this basis I would advise the farmer to commence to fathom the mysteries of successful poultry breeding.

When these fifty produce ten dozen eggs yearly, double the flock, never forgetting that cares increase in like ratio. Learn the A, B, C of poultry raising before you embark upon the troubled waters, and there will be no cause to regret the step. A man must grow into it slowly, if the full measure of success is to be his. While I am ready to affirm that there is no branch of farm industry yielding such a per cent as the poultry yard may yield, I should be false to every honest consideration if I failed to present the obstacles to be overcome.

One of the greatest, and one that creeps in unawares, is the pest of vermin. The best treatment is prevention, and that calls for constant watchfulness. In proportion as cleanliness is observed, lice will be kept away. Whitewash often; use kerosene on, around and underneath the roosts; wash out the laying boxes frequently; provide an abundant dust bath, and vermin can hardly get a foothold. It doesn't pay to support an army of these. It costs too much to feed them.

I do not stand here to mislead, but, if possible, to encourage and assist the farmers and smaller breeders in making the farms of New England more productive and wealthy.

One item in poultry breeding is too often entirely overlooked; and that is, the dressing. If floorings are provided under the roosts, and cleaned at least twice a week, the sweepings placed in some dry receptacle, and covered with absorbents, the spring will find you well prepared to economize in the purchase of dressing. Properly protected and prepared, it is one of the most valuable fertilizers we can have, provided it is made from a variety of sound grain. At one dollar a barrel, — the price paid by farmers in my State, — it amounts to nearly forty cents a head yearly, or fully half the cost of keeping. If left under the roosts, its value soon departs, while its bulk is materially reduced.

I have made no attempt to touch the specialties of this feature of farm work, because these have been most ably and exhaustively treated in former papers, by men of long experience and recognized ability. At the request of your Secretary I have attempted a plain, unvarnished tale, from the stand-point of the average farmer. The notable examples to be seen all over this State, showing what men can do when they put themselves heartily into this industry, are proof positive of its value. The line of operations I have attempted to outline will not give the returns secured by these specialists; but it will surely lead to results perfectly satisfactory to him who patiently works out the problem. There is money in the poultry yard, and it is not so much a difference in breeds as it is in men. Breeds, as I have attempted to show, are what men make them. Men make themselves. Success here, as everywhere, hinges on earnest effort, intelligent appreciation, and patient, persistent application.

Men who reach out after the grandest possibilities, and who labor earnestly and faithfully in any honorable occupation, will realize success. It is not in Arizona or Dakota, but upon the farms of New England, that sure returns come to him who applies himself to this chosen field, conforming his work to the demands of the day, keeping his ear open to the calls of the market, throwing all his energies into the balance for better culture and improved breeds, and himself being builded up in all the essentials of a noble life.

QUESTION. I would like to ask the speaker to give us a little more in detail the history of the Plymouth Rocks.

Dr. TWITCHELL. They originated from several crosses. It is claimed that three or four parties brought them out about the same time. The cross was with the Hamburgs, the Dominiques and the Brahmas. They appeared about 1865. The first exhibition of Plymouth Rocks was, I think, in that year.

Mr. FULLER of Lancaster. Is it a fact that more eggs can be produced by having male birds with the hens?

Dr. TWITCHELL. I don't think that makes so much difference as the food. Some of the most successful breeders that I know of are not in the habit of keeping males with their hens until perhaps ten days before the breeding season opens.

QUESTION. How long after introducing the males would you expect results?

Dr. TWITCHELL. The fourth or fifth egg. If the hens have been running alone, I should expect that the eggs would be fertilized after the second or third; but for a certainty I would wait until the fourth or fifth.

QUESTION. After removing the first male and mating up with a new one, then how long?

Dr. TWITCHELL. From the sixth or seventh egg. The energy of the first male will have much to do in determining that matter.

QUESTION. Does the first mating affect the progeny of the second mating in the least?

Dr. TWITCHELL. That is a difficult question to answer, there are so many things entering into its determination. The virile energy of the birds, the prepotency of the blood, would have much to do in determining the question. It is a question that cannot be determined absolutely, because there are so many things entering into the problem.

QUESTION. Supposing a hen of one breed got by accident with a male of another breed, what course would you pursue?

Dr. TWITCHELL. I should be careful for two or three weeks. I would not send out any of the eggs until after I had made a test of them. I think for two or three weeks, surely, you might expect trouble. If the male whom you introduce is one strong in his own energies, you would be safe after the second or third week from the danger of contamination.

QUESTION. Would you recommend allowing the males and females of different breeds to run together until about the time you wish to mate them?

Dr. TWITCHELL. No, sir; for the very reason that when we come to breeding we want strong and vigorous chickens; we don't want eggs that are poorly fertilized. We want eggs that are fertilized so that the chickens will come out of the shells strong and healthy. Therefore, I would keep the males from the hens until perhaps ten days or a fortnight before I wanted them to breed. I would keep the males by themselves, storing up energy. I think in that way we get better results.

Question. I would like a little further explanation about your method of procuring worm food. I think you spoke about buying meal worms for your hens.

Dr. Twitchell. I have in times past procured at the bird stores meal worms, as we call them. You can get them sometimes at the grist mills. They are the same worms which, perhaps, some of these ladies have found when they have cleaned out a box which had had rye meal in it for some time. The grocery men sometimes find them. I usually have a box of meal which I keep in a warm place, and occasionally wet the meal with sweetened water, and very soon large quantities of these worms are developed.

Mr. Cheever. I understand that this worm in its natural growth develops into the snapping beetle, and that the increase of the species can only be from the eggs of the snapping beetle.

Dr. Twitchell. I thought when I wrote that passage that very likely some question would come up as to the development of the worm, and what it developed into, which I should be unable to answer; but I have bred those worms in meal in boxes.

Question. Is it not the yellow wire worm?

Dr. Twitchell. No, it is not a yellow worm, it is almost white. In appearance it is something like the worms that you sometimes find in tainted meat. It is about half an inch long.

Mr. Cheever. I do not know of any worm that is developed except into a winged insect.

Dr. Twitchell. I do not know but this would, but I have grown the worms in that way.

Question. About what is the maximum number of hens that it is proper to keep with a male bird, if you want to use the eggs for hatching?

Dr. Twitchell. Something would depend upon the variety. The large birds, Plymouth Rocks, Brahmas and Asiatics, I should say eight to twelve; the Leghorns, twelve to eighteen. There, as before, would come in this same question of the condition of the male.

Question. How many times a day do you feed them?

Dr. Twitchell. I have fed twice a day the last few years; or rather, twice a day a regular ration; and at noon I give them a little cabbage or onion or apple or turnip, or something of that kind,—a small quantity.

QUESTION. Is green food necessary in winter?

Dr. TWITCHELL. I thought I had made that clear. I would feed green food of some kind every day.

QUESTION. I understood that you fed clover, and I did not know whether or not in the winter time you would feed that dry.

Dr. TWITCHELL. I would feed cooked vegetables with the clover. I would give all the variety of green food possible. Steam the clover after chopping.

QUESTION. How often would you feed little chicks two or three days old?

Dr. TWITCHELL. Five times a day.

QUESTION. Would you advise keeping food before them all the time?

Dr. TWITCHELL. No, sir; I never keep food before any of them. There must be time for rest and digestion.

QUESTION. You said that in their natural state they pick up kernel after kernel all the time.

Dr. TWITCHELL. I say "kernel after kernel;" but there is considerable time intervening, and the birds are working about all the time. We take them from a natural state, in which they are searching for a kernel at a time, and of course the work of digestion is going on all the while. We take them from that condition and bring them into an unnatural condition when we feed them a crop-full at a time; and, when fed in that way, there should be time for that food to be taken care of before the crop is filled again. I never would feed an animal all it could eat, because animals, like men, acquire bad habits, and they eat more than they ought to.

QUESTION. I would like to ask the essayist if he has ever tried to ascertain the difference in feeding value of different vegetables, say turnips, potatoes, etc.

Dr. TWITCHELL. I have not. If I were growing ducks, I would use turnips very largely. I have always fed turnips to my poultry more or less, but I have aimed to feed them as many varieties of vegetables as possible.

QUESTION. Would you cook turnips for ducks?

Dr. TWITCHELL. Yes, sir; cook and mash. If you want information about ducks, there has been a paper published from Mr. Rankin, in which he has taken up the question of feeding ducks very scientifically. He has scored a success that has not been obtained by any other man that I know of in America.

Mr. SANFORD. I have known several to make a complete failure in the poultry business, on account of vermin that infested their fowls. I have known people who kept their poultry out of doors until cold weather. I would like to know whether, in the opinion of the lecturer, it is possible to keep say a hundred hens together in a house through the year, and keep off these mites.

Dr. TWITCHELL. These mites are the hardest creatures to get rid of that we have. They do not cost us anything when they come, and they stay by us after they have eaten up all the profits. It is a good plan to colonize poultry. I use a little building, four by eight feet long, with three and one-half feet posts. I nail two cross-pieces to the posts, and then clapboard over the side and roof, leaving the front open, letting the two cross-pieces run out so that two men can take the little house up and carry it wherever they please. I keep from ten to twenty hens in a house, and move it once or twice a week, thus giving them a chance to range the fields. That gives me an opportunity to clear out my hen-house and thoroughly fumigate it by burning sulphur. Then, with the free use of kerosene, I have not been troubled with these little mites. I know no better way of getting rid of them than by thoroughly fumigating with sulphur, and the use of kerosene freely about the roosts, and whitewashing. I would have everything in the poultry house movable, so that I can take out everything inside, leaving the bare walls, thus getting a good opportunity to get rid of the pests.

QUESTION. I would like to ask the gentleman's opinion as to the use of incubators.

Dr. TWITCHELL. An old gentleman in Maine was once elected as a representative to the Legislature. He was not a man of great intelligence, and they took him because he was the only man in town they hadn't anything against. They do that sometimes. He went to the Legislature, and did not say a word until about the close of the session, when he felt he must say something to satisfy his constituents. A question came up one day in which he was not particularly interested, but he rose and said, "Mr. Speaker, upon the question now before the House I desire to remain a nuisance." Now, coming back to your question, I will say that I have used incubators and I have used hens; and if I should enlarge my business again, I should use the hens, and very likely I should use the incubators. There is where I stand on that question. I assure you, gentlemen, it is very much easier to get a chicken into the world than it is to care for it afterwards. There is the great secret. I do not think it turns on the question of the use of the incubator at all. The great question is, how to take care of the chickens after they come, to keep them growing, keep down vermin, and give them proper rations.

Question. How can we prevent gapes in chickens?

Dr. Twitchell. The gapes in chickens is caused by a little worm in the throat, resulting from moisture and filth. I have tried in breeding to prevent all forms of vermin from getting about my nests. I do not know that I have been very successful, but I have aimed especially to keep them off of the little chicks. I thought at one time that I discovered gapes in one of my chickens, and I went for the little fellow with a horse hair; but I did not find the worm, and the chicken died. I have never been troubled with them beyond that. All the advice I can give is from those who have had experience, and it is this: take a horse hair, make a loop in it, open the mouth, pass the horse hair down into the windpipe and remove the worm, which lodges there.

Dr. Fisher. I want to say a word or two about poultry vermin. I used to have vermin enough. I kept my poultry out of doors, and they were overrun with them; but for fifteen years I have not had any, and I have put lousy fowl in among mine two or three times. I think you will not find a louse in my house at the present time. I do not do anything for them. I have never used sulphur, never have used whitewash, never have used kerosene; but I will tell you what I have done: the floor of my poultry house is made of cement, and I put in about an inch of sawdust. Since that I have never added anything. Occasionally I have taken out the poultry droppings. They are being stirred up all the time, and the floor is always dry, never moist. There is not a day in the year but what my hens will dust. They have artificial heat near by, so that it is so warm there that water never freezes in winter; and every sunny day through the winter they will dust there as freely and nicely as they will in the summer or in autumn. That dusting is amply sufficient to keep them free from lice. The house is cleared out once in two, three or four years, and nothing else done to it. Whenever the fertilizer accumulates, or whenever I want to use it, I take off about an inch of it. The remaining inch keeps my poultry entirely free from vermin all the time. If anybody can do it any cheaper than that, I should like to know it.

Secretary SESSIONS. There is one question which it seems to me ought to be considered here. You know that occasionally eggs become very plenty in the country, and it is difficult to sell them; and you know that occasionally the price of poultry gets very low, especially about Thanksgiving time, and we get a very small price per pound. Then, again, as I go around the country, I hear some men say that the West is going to kill out our spring chicken business, and that the time is near at hand when the price of poultry and eggs is going to be so low that there will be no profit in the business. I should like to have the views of the essayist as to the probability of that prediction being fulfilled.

Dr. TWITCHELL. That is a question of a great deal of importance; but before I touch upon that, there is one thing I would like to say that was suggested by what Dr. Fisher has said. In speaking of building a house and filling in between the sills four inches of dry earth, I had in mind the very thing which he secures by the use of sawdust; that is, providing a good dust bath and also a receptacle to hold the droppings, where they can be dried and taken care of. These droppings will give you a large amount of valuable manure, and when it is removed this dry earth will afford the hens a good opportunity to dust, and the building will be kept clear of vermin.

Now, as to this question of overproduction, farmers raise the question almost everywhere, — "Well, supposing every farmer goes into the business, what is going to be the result?" I know farmers who have been debating the question of the expediency of going into the poultry business for five years, and have not dared to do so because they feared there was going to be overproduction; and yet we import sixteen million dozens of eggs annually, for which we pay about fifteen cents a dozen, amounting to some $2,400,000. Now, until we can meet the demand at home, let us not cry "overproduction." What we want to do with our hens is just what some farmers have succeeded in doing with their cows. We want to shift them from summer production to winter production, as cows are shifted from summer to winter dairying. We want to shift our hens so as to get the largest number of eggs in winter. I believe it to be possible to do this by a system of breeding that will bring our hens to laying in November, and then feeding them for the production of eggs during the winter months. There can be no such thing as an overproduction of a choice article; it is practically impossible. The choicest will always be wanted, whether it be eggs, butter, or brains.

Secretary SESSIONS. Can you recommend any particular date for the hatching of chicks for early eggs?

Dr. TWITCHELL. A pullet comes to laying usually when it is five months old; some earlier and some later, but that would be about the average. The Leghorns would come a little earlier, the Asiatics a little later. You want, then, to hatch your chickens in May for fall layers. Chickens hatched in May should come to laying in October or the first of November; at least, if they are kept in good condition and if the buildings are kept fairly comfortable, — not overheated. I should dread that more than I should the cold. If they are kept in good, comfortable condition, and attention is paid to feeding, they should lay right along for two or three months. By that time the hens that you have summered over (and almost everybody keeps a few) will take up the work, with the August and September chickens. I think that is the most profitable way to grow them.

The Chairman. There is one gentleman present who is largely engaged in raising broilers for the market, — Mr. Hines of Townsend. Will he give us some light on the question?

Mr. Hines. Our worthy chairman says I am largely engaged in raising broilers. He is rather mistaken in that, for I am only a child in the business, as yet. I have raised a few the past two or three years, and am preparing to engage in it on a little larger scale. I think it is the most profitable part of the poultry business; it has been to me, so far as I have gone into it. There are two or three points in this early-chicken business which I want more light upon. One is this: If a hen has laid several litters of eggs for hatching, does that have such an effect on her next eggs that they will not produce as vigorous chickens as the first litter? Another question which I would like to have answered is this: Does the feeding of hens to produce a large number of eggs tend to made them incapable of producing strong, vigorous chickens? If I could get light upon those two questions, and also upon the question of using artificial incubation, I should feel that the poultry business was a pretty good business for me to engage in. My trouble has been, in attempting to get early chickens, in getting a good per cent of my eggs to hatch. I can get them early, my chickens grow from one to two weeks, some of them up to eighteen or twenty days, and then they die in the shell. If any man will tell me what the cause of that is, he will help me considerably. I have been led to think that that depends largely upon the feed we give our hens, and upon the quantity of eggs they have laid previously, as well as upon the temperature and moisture of the incubator. I think all these points come in largely in this early-chicken business.

I will give you the benefit of a little experience I had last spring, which perhaps will illustrate this point as well as anything I can say. My hens commenced laying in October and November last fall. In February I commenced filling my incubator. My first hatching did not give me a very good percentage of chickens. I had a neighbor who had a very sunny exposure, where the snow went off early and left the ground bare. His hens were scratching about among the leaves, and did not lay until warm weather came on. I noticed his hens out there under the trees, and I thought I would stop and buy some of his eggs. I did so, and put five dozen of his eggs into my incubator, and filled it up with my own. From that five dozen I got forty-three vigorous chickens, while from my own eggs I only got about thirty-three per cent instead of sixty per cent. This experience led me to conclude that there was much depending upon hens being in their natural condition to give me what I wanted. Of course neither of those percentages is what I want to get. If I could find any system that would give me eighty per cent of hatchable eggs, I would not ask for any better branch of farming.

I want to urge this question upon the experiment stations. I presented it to Dr. Goessmann, and he gave me a favorable reply, saying that he would try to have something done. My question is, why do not our experiment stations, while experimenting upon the feeding of dairy stock and the analysis of feeds suitable for the dairy, pay some attention to the poultry interest? I do not know but there may be some experiment stations that are doing something for us upon this question, but I fail to discover it, if they are. There is a good chance for experimenting on the food that will produce eggs that will produce the most vigorous chickens. It seems to me that when chickens grow fifteen or twenty days in the shell, and then die, there is something lacking in the egg. It is not a perfect egg. The ration was not perfectly balanced, as the speaker has said to-day, and was adapted to the production of a large quantity of eggs instead of the production of eggs that would produce strong, vigorous chickens; and hence the chickens grew until there was a lack of material to build up the system. I would like to ask the speaker whether there is anything in that idea, or not.

Dr. Twitchell. A chicken grows as long as there is anything in the egg for it to feed upon, or as long as there is any virile energy remaining. In the case the gentleman mentions, I think there must have been something lacking in the feed, or there was something wanting in the stock; unless the illustration furnished by the gentleman of his neighbor who allowed his hens to run out and work in the leaves, and he secured from the eggs of those hens a much larger per cent of chickens than from his own, where the hens were confined, is the solution of the problem. If so, then it would seem that just as soon as our hens get to work upon the land in April, the eggs begin to hatch and the chickens are strong and healthy. Now, if we can imitate Nature more, and keep our hens at work, it is the best thing we can do for them. Work is good for us, — it is a good deal easier to preach than to practice, I grant, but it is good for us, and it is good for hens. If we can keep them at work constantly, we shall have less trouble about the eggs hatching. Keep both the males and the females at work, and feed them to prevent the accumulation of fat; feed them on albuminous food, with a percentage of fat sufficient to maintain animal heat. The trouble with us all is, that we like to see our birds in fine condition, with glossy feathers. That comes, we know, from oil, and so we feed substances that will produce fat. Experience is a pretty expensive teacher, but it gives us some very good lessons before we get through.

To turn back to the other question. If your hens commence laying about the first of November, and you do not use the eggs for hatching until January or February, I should not expect the eggs would be as vigorous, because you have been taxing the reproductive organs in production. I would try to keep them down below the egg-producing point until about the time when you want to use the eggs for hatching. If, when you go home from this meeting, you find that your hens are fat and are not laying eggs, change your system of feeding to one that will reduce flesh, and the eggs will begin to come.

Mr. Hines. I have had a little experience in dressing Plymouth Rocks that were from one to two years old. I have heard it remarked that hens were fat because they did not lay eggs; but I have often dressed Plymouth Rocks which were very fat, and I would find them full of eggs. They had been laying every day, and yet the fat would be an inch thick all around the eggs. This experience would seem to contradict your statement.

Dr. Twitchell. I think it is, nevertheless, true that a hen that is extremely fat cannot produce eggs with the same regularity that she would if she were in proper laying condition. If albuminous food is given to a hen that is well bred, she will produce eggs; but fat is prejudicial to a large, constant and steady production of eggs.

Question. Is it advisable to keep a hen until she is more than a year or a year and a half old?

Dr. Twitchell. It has been my custom to carry my hens along until they were two years old, if they were valuable layers, and kill them then before moulting, watching closely and studying individuals. We should never be content with the average of our flock. That does not tell the story at all. We must get down to individuals, because there is always some hen in a flock that the rest of the flock are carrying. So I would seek to know my flock, and just as soon as a hen has stopped laying during the month of June or July, I would market her if she was two years old; and at that time she would bring the highest price, close to that of chickens, because it is just the time when chickens of the largest size, broilers, are called for, and there is not sufficient supply to meet the demand. I would never keep them longer than that, unless they were extremely valuable for breeding purposes; and some of the breeders in my own State who are making the most money change their stock every year.

Question. What would you buy for green food, if you had to buy anything?

Dr. Twitchell. I would feed cabbage, turnips, apples and onions.

Question. How about the mangel-wurzel?

Dr. Twitchell. I have never had success in feeding mangel-wurzel. I have fed some, but I have not been satisfied with the result.

Question. How often would you feed onions?

Dr. Twitchell. I would feed a small ration of onions once or twice a week. If you feed in any quantity, you will taste the onion in the egg. And there comes in another point. A radical change in rations will throw a hen at once off from her work. If any change is to be made in rations, make it so gradually that her system will have time to adapt itself to the change. That often accounts for the fact that hens that have been laying well will stop laying all at once. We cannot control these things yet, feed we ever so carefully.

QUESTION. Don't you think that the oldest hens will produce the strongest and best chickens?

Dr. TWITCHELL. I said that I would save the oldest hens for breeding. I would not keep them after two years, unless I knew they were valuable.

QUESTION. You spoke of giving hens green food. Do you cook that food, — turnips, onions, cabbages, etc., — or do you give it to them raw?

Dr. TWITCHELL. I think I stated in my paper that I cooked daily a kettle full or more. I said I would add about three quarts of this cooked food to the ration. I have always been in the habit of feeding at noon green food, chopping my apples, onions, turnips and cabbages.

The audience desiring to take advantage of the trains leaving Fitchburg at four o'clock, the meeting was adjourned somewhat abruptly at 3.45 P.M.

ANNUAL MEETING.

The Board met at the office of the Secretary, in Boston, on Tuesday, Feb. 4, 1890, at 12 o'clock, it being the Tuesday preceding the first Wednesday in February. In absence of the Governor, Mr. WOOD was chosen President *pro tem.*

Present: Messrs. Bird, Bowditch, Clark, Clemence, Cruickshanks, Currier, Cushman, Edson, Gardner, Goddard, Goodell, Hartshorn, Hayden, Hersey, Hickox, Holbrook, Howe, Howes, Newhall, Peterson, Rawson, Rowley, Sheldon, Snow, Stockwell, Taft, Taylor, Varnum, Ware and Wood.

Voted, To adopt the usual order of business.

Voted, To dispense with the reading of the records of the last meeting.

A committee of three, to examine and report upon the credentials of newly elected members, was appointed by the Chair: Messrs. Goddard, Sheldon and Bird.

Reports of delegates being in order, the members made report of the societies to which they were assigned, which reports were discussed and laid on the table.

On motion of Mr. Hersey, a committee of three was appointed, to prepare resolutions on the death of Avery P. Slade of Somerset: Messrs. Hersey, Bowditch and Peterson. On motion of Mr. Varnum, a committee of three was also appointed, to prepare resolutions on the death of Dr. James P. Lynde of Athol: Messrs. Varnum, Cruickshanks and Taft.

Adjourned to 2.30 P.M.

Board called to order by Mr. WOOD, at 2.30 P.M.

The committee on credentials of newly elected members reported the following: —

At large, appointed by the Governor, James S. Grinnell of Greenfield.

From the Worcester North-west Society, to fill out the unexpired term of Dr. Lynde, Wm. H. Bowker of Boston.

Bay State Society, F. H. APPLETON of Peabody.
Bristol County, N. W. SHAW of North Raynham.
Deerfield Valley, J. D. AVERY of Buckland.
Essex County, B. P. WARE of Clifton.
Highland, HIRAM TAYLOR of Middlefield.
Hillside, WM. BANCROFT of Chesterfield.
Middlesex South, S. B. BIRD of Framingham.
Plymouth County, AUGUSTUS PRATT of North Middleborough.
Worcester, C. L. HARTSHORN of Worcester.
Worcester North, GEO. CRUICKSHANKS of Fitchburg.
Worcester County West, P. M. HARWOOD of Barre.

The report of the committee on credentials was accepted.

Mr. Varnum, for the committee to report resolutions on the death of Dr. Lynde, reported the following: —

Whereas, In the wisdom of Divine Providence, Dr. James P. Lynde of Athol, a member of this Board, has been suddenly removed by death; and

Whereas, We desire to place upon record some acknowledgment of the valuable services which he has rendered during a long period of time, and some token of respect for his memory; therefore, be it

Resolved, That we received the notice of the death of our late associate with feelings of profound sorrow.

Resolved, That, in this sad event, this Board mourns the loss of a faithful friend and public servant, whose scrupulous fidelity to duty and whose intelligent and unselfish labors have embalmed his memory in our hearts.

Resolved, That we tender to his bereaved family our kindest sympathies, and such consolation as long and friendly associations with the deceased can offer.

Resolved, That these resolutions be spread upon the records of this Board, and a copy sent to the family of the deceased.

After appropriate remarks by Messrs. Taft, Bowker, Goodell, Varnum, Hersey, Peterson and the Secretary, the resolutions were adopted unanimously, by a rising vote.

The report of the examining committee of the Agricultural College was read by the chairman, Geo. Cruickshanks, and was by vote of the Board accepted, and adopted as the report of the Board of Agriculture to the Legislature.

At 5 o'clock the Board adjourned to 9.30 o'clock, Wednesday.

SECOND DAY.

The Board met at 9.30 A.M., Mr. WOOD in the chair.

Present: Messrs. Appleton, Avery, Bancroft, Bird, Bowditch, Bowker, Bradley, Clark, Clemence, Cruickshanks, Currier, Cushman, Edson, Fernald, Gardner, Goddard, Goessmann, Goodell, Hartshorn, Harwood, Hayden, Hersey, Hickox, Holbrook, Horton, Howe, Howes, Newhall, Peterson, Pratt, Rawson, Rowley, Shaler, Shaw, Sheldon, Snow, Taft, G. S. Taylor, H. Taylor, Varnum, Ware and Wood.

Minutes of yesterday read and approved.

A committee of three, on assignment of delegates, was appointed: Messrs. Ware, Howe and Taylor of Middlefield.

A committee of three, on place for holding the public meeting, was appointed: Messrs. Taylor of Chicopee Falls, Cruickshanks and Currier.

A committee of three, on changes of time of holding fairs, was appointed: Messrs. Rowley, Sheldon and Pratt.

A committee of three, on essays, was appointed: Messrs. Hersey, Goodell and Holbrook.

A committee of three, to nominate members of the executive committee, was appointed: Messrs. Taft, Hickox and Clemence.

A committee of three, to nominate members of examining committee of the Agricultural College, was appointed: Messrs. Rawson, Gardner and Bowker.

Voted, That the time for the election of Secretary be fixed at 2.30 o'clock P.M.

Mr. Hersey, for the committee to prepare resolutions on the death of Avery P. Slade, presented the following resolutions: —

Whereas, The death of Avery P. Slade has removed from this Board one who for many years has been an able and faithful working member, —

Resolved, That in his death we lose a kind and genial associate, a wise counsellor, and a member who was always found working for the best interest of the Board.

Resolved, That his thorough knowledge of the best methods of increasing the products and profits of the farm and garden, and his willingness to impart it to the public, make his death a great loss to the farmers in all parts of the State.

Resolved, That we extend to his bereaved family our most heartfelt sympathies.

Resolved, That these resolutions be spread on our records, and a copy be sent to the family of the deceased.

After appropriate remarks by Messrs. Hersey, Cushman and Pratt, the resolutions were unanimously adopted, by a rising vote.

J. H. Goddard read an essay on "Choosing an Occupation," which was accepted, and will be found printed in this volume.

Voted, On motion of Mr. Ware, that all societies receiving the bounty of the State be required, immediately after the awards of the several committees are made, to cause to be attached to each animal or article to which first premium has been awarded, a blue ribbon or card, with "First Premium" printed thereon; and to each animal or article to which second premium has been awarded, a red ribbon or card, with "Second Premium" printed thereon; and to each animal or article to which a third premium has been awarded, a white ribbon or card, with "Third Premium" printed thereon, — to the end that a uniform practice may be followed by all the societies; and that the Secretary inform the officers of each society of this action.

The committee on changes of time for holding fairs reported that the time for holding the Bristol County be changed to the sixth Tuesday after the first Monday in September; the Worcester North-west to the fifth Tuesday after the first Monday in September; the Middlesex South to the second Tuesday after the first Monday in September; the Barnstable to the second Tuesday after the first Monday in September; and that the last two days of the Massachusetts Horticultural be dropped from the schedule. The report was accepted and adopted.

The committee on place for holding the public meeting reported, by their chairman, that the meeting should be held at Worcester. The report was accepted, and the Board voted to hold the next public winter meeting at Worcester.

The Board at 12.30 adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. WOOD in the chair.

The committee to report names for the examining committee of the Agricultural College reported the nomination of George Cruickshanks and P. M. Harwood for three years, — who were elected.

The committee to report names for executive committee reported as follows: Messrs. Bowditch, Hersey, Hartshorn, Rawson and Hickox, — who were elected.

A committee of arrangements for the public meeting, to act with the Secretary, was appointed: Messrs. Hartshorn, Clemence, Stockwell, J. G. Avery and Harwood.

Voted, On motion of Mr. Bradley, that the State Board recommend the several societies to employ experts to award the premiums on all live stock, including poultry.

It being 2.30 o'clock, the special assignment — the election of Secretary — was called up, and William R. Sessions was re-elected.

On motion of Mr. Hersey, the Board proceeded to a ballot for member of the Board of Control of the State Experiment Station, to fill the vacancy caused by the death of Dr. Lynde. P. M. Harwood was elected.

Report of the Board of Control of the State Experiment Station, presented by the director, Dr. Goessmann, was accepted.

Dr. Wm. Holbrook read an essay on "Tuberculosis," which was accepted, and will be found printed in this volume.

By permission of the Board, the Secretary read a communication from Dr. Geo. B. Loring, upon the same subject, which will also be found printed in this volume. After discussion of the above essays, the Board adjourned, at 4.30 P.M., to 9.30 A.M., Thursday.

THIRD DAY.

The Board met at 9.30 A.M., Mr. Wood in the chair.

Present: Messrs. Appleton, J. G. Avery, Bancroft, Bird, Bradley, Bowker, Clemence, Cruickshanks, Currier, Edson, Goessmann, Goodell, Hartshorn, Harwood, Hayden, Hersey, Holbrook, Horton, Howe, Newhall, Peterson, Pratt, Rawson, Rowley, Shaler, Shaw, Sheldon, Stockwell, Taft, H. Taylor, Varnum, Ware and Wood.

Minutes of yesterday read and approved.

The committee on essays for next annual meeting reported as follows: —

Essays.

The Farmer, his Relations to the Manufacturer and Mechanic, ...	J. G. Avery.
Essentials to Success in Farming, . . .	P. M. Harwood.
The Promotion of Agriculture, . . .	F. H. Appleton.
Care and Management of Milch Cows, . .	G. L. Clemence.
Can this Board broaden and improve Its Work?	Wm. H. Bowker.

The report was accepted.

J. H. Rowley read an essay on "Agricultural Societies and Their Management," which was accepted, and will be found printed in this volume.

By permission of the Board, the Secretary read an essay upon "Farming in England," prepared by Dr. Geo. B. Loring, which will be found printed in this volume.

The reports of the delegates to the several societies were read a second time by their titles, and accepted.

President Goodell moved the following resolution: —

Resolved, That the Massachusetts State Board of Agriculture, recognizing the danger threatening the agricultural interests of the State by the sudden appearance in the town of Medford of a dangerous insect pest, petition the Legislature, in support of the petition of the citizens of Medford and adjacent towns, for State aid in stamping it out. The resolution was unanimously adopted.

Prof. N. S. Shaler read an essay on "Soils of Massachusetts," which was accepted, and will be found printed in this volume.

At 12.30 the meeting adjourned to 2 p.m.

Meeting called to order at 2 p.m. by Mr. Wood.

On motion of Mr. Varnum, it was voted that the executive committee be also a committee on printing.

Mr. Ware, for the committee on assignment of delegates, reported the following: —

Amesbury and Salisbury,	J. H. Rowley.
Barnstable County,	S. A. Hickox.
Berkshire,	D. A. Horton.
Blackstone Valley,	G. J. Peterson.
Bristol County,	W. H. Bowker.
Deerfield Valley,	N. Edson.
Eastern Hampden,	F. K. Sheldon.
Essex County,	P. M. Harwood.
Franklin County,	S. B. Bird.
Hampden,	C. W. Gardner.
Hampshire,	J. G. Avery.
Hampshire, Franklin and Hampden,	A. Pratt.
Highland,	E. Hersey.
Hillside,	J. D. Avery.
Hingham,	J. S. Grinnell.
Hoosac Valley,	J. C. Newhall.
Housatonic,	C. L. Hartshorn.
Massachusetts Horticultural,	G. Cruickshanks.
Marshfield,	N. S. Shaler.
Martha's Vineyard,	D. M. Howe.
Middlesex,	G. L. Clemence.
Middlesex North,	A. Bradley.
Middlesex South,	A. C. Varnum.
Nantucket,	C. B. Hayden.
Oxford,	W. W. Rawson.
Plymouth County,	W. H. B. Currier.
Spencer,	H. Taylor.
Union,	Wm. Holbrook.
Worcester,	G. S. Taylor.
Worcester East,	J. W. Stockwell.
Worcester North,	E. W. Wood.
Worcester North-west,	W. Bancroft.
Worcester South,	N. W. Shaw.
Worcester County West,	V. Taft.

Report accepted and adopted.

On motion of Mr. Hartshorn, it was voted that any unfinished business or any new business that may arise, be referred to the executive committee, with power to act for the Board.

On motion of Mr. Hersey, a vote of thanks was unanimously tendered the chairman, Mr. Wood, for the able, courteous and impartial manner in which he had discharged his duty as presiding officer.

The minutes of the last day were then read and approved.

Adjourned.

WILLIAM R. SESSIONS,
Secretary.

REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[P. S., chap. 20, sect. 5, adopted by the Board Feb 4, 1890.]

The Examining Committee of the Agricultural College, appointed by this Board, have the honor of submitting the following report.

In accordance with the requirements of this Board, and the rules by which it is governed, your committee have made such investigations into the condition and methods of the college as seemed to be necessary, in order to determine its value and efficiency as an educational institution for carrying out the wise purposes for which it was established.

In making this report, we do not need to give a history of the college, or the work that has been accomplished during its existence, or even during the past year, in detail (the annual report of the president and trustees will do that); but a few general statements as to the purposes of the college, and how we came by it, may be interesting to those who have not paid special attention to the subject.

Act of Congress.

It is generally known that the agricultural colleges of the various States are the result of an Act of Congress, passed and approved by the President July 2, 1862, entitled, "An Act donating public lands to the several States and Territories, which may provide colleges for the benefit of agriculture and the mechanic arts." The grant was in proportion to the population of the several States, and must be accepted by their several legislatures, in order to become available. The act specially provided that the interest of the fund realized from the sale of the land scrip should be faithfully applied "to the endowment, support and maintenance of at least one college, where the leading object shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

Act of the Legislature.

In accordance with this grant, an act was passed by the Massachusetts Legislature, and approved April 29, 1863, accepting this grant, and constituting certain carefully selected gentlemen (whose names appear in the act *), with their associates and successors, a body corporate, under the name of the "Massachusetts Agricultural College."

The Legislature also provided that all moneys received by virtue of this act (accepting the grant), for the sale of land scrip, should be deposited with the treasurer of the Commonwealth, who should invest the same as a perpetual fund for the promotion of education, according to the act of Congress.

The College Located.

The town of Amherst having raised the sum of $75,000 in aid of the enterprise, the college was located there; the necessary buildings for beginning the work were erected, and the college began with its first class Oct. 2, 1867.

After more than twenty years of earnest effort, and with a varied experience, having had its ups and downs, like many other worthy enterprises, the college at the present time is equal if not superior to any of the kind in this country. The college buildings occupy a commanding site, about a mile north of the central village, and the surrounding scenery is enchantingly romantic. The college is supplied with a competent corps of teachers, who are, without exception, we believe, faithful and enthusiastic in their work of preparing young men for practical life.

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* 1863, chapter 220.

College Farm.

Upon the establishment of the college at Amherst, a farm of 383½ acres was purchased, from six separate estates. It is described in former reports under three heads: —

1. That part leased to the Massachusetts Experiment Station, consisting of about 48 acres. This is under the direction of Dr. Goessmann, director of the station.

2. That part used by the botanic and horticultural department of the college, under the direction of Prof. S. T. Maynard.

3. The land lying on the westerly side of the county road, which is designated as the farm proper, of which about 125 acres are under cultivation in mowing and tillage. This year there are 20 acres in corn, 2 acres in potatoes, 2 acres in root crops, and about 100 in grass.

No practical farmer of Massachusetts can visit the farm and experiment station connected with the Agricultural College, without being impressed with the fact that the farmers' interests in Massachusetts are well looked after. Your committee are happy to be able to say that we visited all the grounds and buildings of the institution, and have examined, so far as we were able, the experiments that were being made. We visited the gardens, and found that the culture of strawberries, of tomatoes, and some other plants which interest the gardener and small fruit grower, were being experimented with; and, while the professor in charge was not at home, his assistant was ready and able to show and explain the work. We visited the several greenhouses, and found all in good condition for the season of the year. Visiting the orchards, we were invited to taste the fruit; and it needed but one invitation for us to accept of the tempting, red-cheeked peaches. They are experimenting with the peach crop, which of late years has become an almost unknown crop in New England. They have succeeded in raising fine fruit of the different varieties. The great variety of pears shows the care that is taken there. They find a good market in the town close by, at good prices; and we have no doubt they can show to the farmer that he can raise fruit of all kinds as a money-making crop.

The cool cellars for the keeping of fruit cannot fail to interest the grower and seller of fruits. No one can visit the stables, where the experiments are going on with cattle and horses, and see the great care and neatness shown there, the fine pens for pigs, the exactness with which they are fed, without being convinced that the money expended was not wasted. We visited the fields, where all kinds of forage crops were being raised, also the grain and root crops ; and it was a great pleasure to us to see the enthusiasm exhibited by professors, teachers and students. They do not act as if they were at their duties, but more at their recreations. Ask a question, and you will get an answer so full and complete that you feel the want of time to ask all the questions that crowd your mind ; for, from the professor to the youngest student, the moment a question is asked, the answer comes with the enthusiasm that at once sets you at ease.

Your committee were more and more impressed with the idea that our farmers did not realize what the State was doing for them at the Agricultural College and Experiment Station in Amherst. There are hundreds of farmers living within twenty miles of Amherst, who have never visited the institution. If they were not welcome, there might be an excuse for this ; but they are not only welcome, but are urged to come. They are making experiments there which but few farmers could afford, and they are for all of the farmers of the State. From all we could learn, the experiments were constantly growing in value and interest. The close and accurate experiments in stock-feeding were not the least interesting to your committee. They were able to tell you how much a pound of beef or pork cost to make from certain kinds of food. They can also tell you how that pound can be made the cheapest, also the kind of frame it is best to make the meat on ; and so in regard to the cost of making milk and butter.

While the experiment station and farm are doing so much, they are, as it were, in their infancy ; and we are pleased to know that the farmers are awaking to the fact that this is in no small degree their institution.

STOCK.

The policy of keeping only pure-bred stock, which is now pursued, has considerably diminished the herd by the sale of grades and such young animals as could be spared. There are now fifty-six head, distributed as follows: —

Ayrshires,	13
Guernseys,	6
Holstein-Friesians,	14
Jerseys,	13
Shorthorns,	10

The sheep are Southdowns, and number 35, — 25 ewes, 6 wethers, 4 rams. The swine are the small Yorkshire breed, and number 40, of various ages.

HORTICULTURAL DEPARTMENT.

The grounds of this department are located on the eastern boundary of the college grounds, with a gentle slope to the west. They are laid out in good taste, and contain many specimens of rare ornamental trees and hardy flowering shrubs, and are all correctly labelled with both the Latin and common names. On these grounds are two plant houses, one of which is used for the experimental work of the Hatch Experiment Station; the other the Durfee plant house, which contains a good collection of stove, greenhouse and aquatic plants, especially adapted to illustrate the work of this department. Attached to this house is a range of propagating pits, where may be practically illustrated the propagation of all the plants grown in the greenhouse. A small nursery is attached to this department, in which are propagated all the hardy fruit and ornamental trees and shrubs, the work of propagation being largely done by the students. An orchard of seven acres, on the most elevated portion of the college grounds, contains all the standard varieties of apple, pear, plum, peach, cherry and quince; a vineyard of one and one-half acres, and several acres of small fruits. New sorts are added from time to time, for comparison and experiment. The diseases and insect enemies that attack the tree, foliage or fruit are subjects of investigation. Experiments are now in progress, the result of which will be looked for with great interest by the fruit grower.

The Botanical Museum.

Besides the recitation room of the professor of horticulture, it contains the Knowlton herbarium, numbering over ten thousand specimens of plants from nearly all parts of the world; a large collection of models of fruits and specimens of wood; and many natural curiosities in tree and plant growth. The students receive instruction in landscape gardening, horticulture, and market gardening.

Anniversary Exercises.

The anniversary exercises took place in June, as usual, on which occasion most of your committee were present. We attended first the exercises called the Kendall prize speaking, on the evening of June 17.

Grinnell Prizes.

The senior class in the examination for the Grinnell prizes came under the special supervision of your committee. It may here be stated that Hon. Wm. Claflin of Boston has given the sum of one thousand dollars for the endowment of a fund for a first prize of forty dollars, and a second prize of twenty-five dollars, to be called the Grinnell agricultural prizes, in honor of his friend George B. Grinnell of New York. These prizes are to be paid in cash to the two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

Topics were assigned to each student, by lot, and included such subjects of interest as the resources and wastes of nitrogen; fruits, and the soils best adapted to their culture; forestry; drainage; the horse; the dairy cow, etc. The examination was conducted by Professor Brooks and your committee, who by frequent questions, suggested by the recitations, aimed to draw out the students, and to get their idea of the subjects given them. An essay on dairying and the characteristics of the different breeds was read by each member of the class. The subject was assigned by the professor, and the essays were written at short notice, and without reference to books. The students acquitted themselves with great credit, showing a good degree of familiarity with the various subjects upon which they were examined.

The class numbered fourteen. The competition was sharp. The first prize was awarded to Burt Laws Hartwell of Littleton, the second to Charles Albion Whitney of Upton.

Military Drill.

At the close of the afternoon session of the examination in agriculture, there was a military drill under George E. Sage, First Lieutenant Fifth U. S. Artillery. The terms of the grant, as we have seen, require that military tactics should be taught at the college; and all students, unless physically disqualified, are required to attend prescribed military exercises. We are informed that the routine of the West Point Academy is followed, as nearly as circumstances will permit. The benefit and importance of this part of the college requirements is manifest. Its tendency is to develop a manly bearing, promote health, confer confidence and promptness of action; and it serves to insure a proper sanitary condition of the college buildings, as the commandant makes a careful inspection of all rooms and college buildings at stated times each week. These military exercises are very interesting, and attract crowds of spectators to witness the commencement exercises.

College Fund.

As we have already stated, the law requires that the money realized for the sale of the land scrip should be deposited with the State treasurer, to be safely and profitably invested as a fund for the college. According to the college treasurer's report for 1889, there are in the hands of the State treasurer funds as follows: —

Funds from the United States grant, . . .	$219,000 00
Funds from the State grant, ...	141,575 35
Total, ...	$360,575 35

By law, two-thirds of the income is paid to the treasurer of the college, and one-third to the Institute of Technology. The amount of income of course is liable to vary, but the amount received for the year 1888 is given as $11,442. By the gift to the Institute of Technology, the requirement of the United States grant is complied with, and the Agricultural College is freed from the labor and expense of building up and maintaining a mechanical department. There are other funds for specific purposes, some of which have been briefly alluded to, and all of which may be seen in the trustees' report of 1889.

INSTRUCTION AT THE COLLEGE.

The work of instruction which is undertaken by the college is in a satisfactory condition. The teachers are able and zealous, the classes are well arranged, and the students seem well-developed, alert, and attentive to their tasks. The appliances for laboratory instruction in the courses which are given are tolerably well adapted to the needs of teachers and pupils.

The principal defects in the equipment of the college are found in the lack of instruction in veterinary surgery and medicine, and in geology; and also in the insufficient collections designed to illustrate the now important facts of these departments. The former of these defects is serious; for a competent knowledge of the simplest parts of veterinary science is of very great importance to the farmer. It is obviously impossible to give an extended course in this science in an agricultural college, for the reason that it would require at least a year of the student's time; but it seems desirable that instruction of a partial kind in the more important parts of the veterinary art should be given, — if not as a regular course, at least as an optional study. Your committee are informed that the college needs apparatus and equipment for instruction in this department; such, for example, as a plastic model of the horse, which can be taken to pieces before the class, and used in the recitation room in the same manner as a manikin. These models are somewhat expensive, but, if needed, should be provided.

The defects in geological instruction and appliances in the way of collections, though serious, are perhaps of less immediate importance; yet this science much concerns the farmer, who should understand the condition of the soils with which he has to deal, and the natural manures on which he has largely to depend for fertilizing purposes. It appears that the present corps of teachers is completely occupied by other duties; moreover, it is eminently desirable that this teaching should be done by an expert in this department, and not by a person who can take up this matter only as a secondary task.

GEORGE CRUICKSHANKS.
SAMUEL B. BIRD.
VELOROUS TAFT.
GEO. S. TAYLOR.
A. C. VARNUM.
N. S. SHALER.

AGRICULTURAL SOCIETIES AND THEIR MANAGEMENT.

BY J. H. ROWLEY OF SOUTH EGREMONT.

Agriculture, the first regular occupation of man, and the parent of all other arts, has been encouraged in all ages of civilization, by the adoption of various methods to promote its interests and develop its resources. Leading minds in all civilized countries have recognized it as the foundation of property, order, and the corner-stone of civil institutions. "A spring that sets in motion the grand machine of business, manufacturing and commercial; nor can a sail be spread without the assistance of the plough. Every other source of independence or of plenty is perishing or casual; this the great art which every inquirer into nature ought to improve." Poets have sung, —

"Hail, Agriculture! Heaven ordained,
  Of every art the source,
Which man has polished, life sustained,
  Since time commenced its course.
Where waves thy wonder-working wand,
  What splendid scenes disclose;
The blasted heath, the arid strand,
  Outbloom the gorgeous rose."

European governments have made its promotion and development a governmental policy, and encouraged it by loans, premiums, and the establishment of agricultural schools and societies. Fully appreciating the advantages of agriculture to the nation, Washington, in his annual message to Congress, in December, 1796, said: —

It will not be doubted, that, with reference either to individual or national welfare, agriculture is of primary importance. In proportion as nations advance in population and other circumstances of maturity, this truth becomes more and more an object of public patronage. Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater success than the establishment of boards composed of proper characters, charged with collecting and diffusing information, and enabled by premiums and small pecuniary aids to encourage and assist a spirit of discovery and improvement? This species of establishments contributes doubly to the increase of improvement, by stimulating to enterprise and experiments, and by drawing to a common centre the results everywhere of individual skill and observation, and spreading them thence over the whole nation. Experience accordingly has shown that they are cheap instruments of immense national benefits. I have therefore proposed to the consideration of Congress the expediency of establishing a national university, and also a military academy. The desirableness of both of these institutions has so constantly increased with every new view I have taken on the subject, that I cannot omit the opportunity of once for all recalling your attention to them.

Highly as the Father of his Country valued an institution for the educating and training of those who were to defend the country, equally as important he considered one for educating those on whom all depended for support. At this date there were but two agricultural societies in the country. The first one was established in 1785, in Philadelphia; the second, the Massachusetts Society for Promoting Agriculture, was incorporated March 7, 1792. The Berkshire Agricultural Society, being the third, was incorporated in 1811, and in 1814 held the first county cattle show and fair in the United States. In 1819 the Massachusetts Legislature passed an act giving to every society which should raise the sum of one thousand dollars for the promotion of agriculture, two hundred dollars annually, and in like proportion for any greater sum, not exceeding three thousand dollars. But so little was the usefulness of these societies understood and appreciated, that strenuous opposition was made to all further incorporation of new ones, which were to receive aid from the State. Thirty-four years later, in 1853, with fourteen societies in the Commonwealth, five or six petitions, asking to be incorporated, were sent to the Legislature, and all denied. But a general act was passed, entitled, "Agricultural, Horticultural and Ornamental Tree Associations."

> Any ten or more persons, in any county, town, or city within the state, who shall, by agreement in writing, associate for the purpose of encouraging agriculture, horticulture, or improving and ornamenting the streets and public squares of any city or town, by planting and cultivating ornamental trees therein, may become a corporation by such name as they shall assume therefor, by calling their first meeting, and being organized in the manner provided in the forty-first chapter of the Revised Statutes, for the incorporation of the proprietors of social libraries and lyceums, and every such association, upon becoming a corporation as aforesaid, shall have, during the pleasure of the legislature, all the like rights, powers, and privileges as the proprietors of such libraries, and may hold real and personal estate, not exceeding ten thousand dollars.

This act, drafted by the Speaker, who participated in the general opposition to chartering more societies to receive aid from the State, was reported by the committee on agriculture to the House, and became a law. It was supposed this would meet all the demands for agricultural societies. This Legislature voiced the sentiments of the people towards institutions of this character. The antipathy against what was termed "book farming" was very strong. Those who advocated the benefits of applying agricultural science to practical agriculture, were ridiculed, called visionary theorists, with utopian ideas of farming. Many farmers were so deeply imbedded in the old ruts of prejudice, as to refuse to avail themselves for a long time of the benefits of improved farming implements, illustrating the truth of what Henry Clay said many years ago, in one of his speeches on the tariff: —

> In one respect there is a great difference in favor of manufactures, when compared with agriculture: it is the avidity with which the whole manufacturing community avail themselves of an improvement. It is instantly communicated and put in operation. There is an avidity for improvement in the one system, an aversion from it in the other. The habits of generation after generation pass down the long track of time in perpetual succession, without the slightest change in agriculture. The ploughman who fastens his plough to the tails of his cattle, will not own that there is any other mode equal to his. An agricultural people will be in the neighborhood of other communities who have made the greatest progress in husbandry, without advancing in the slightest degree.

While the agricultural societies were doing much good by the offering of premiums, thus stimulating competition and exciting a greater interest in agricultural productions, practical agriculture advanced slowly. The several societies were operating without any concert of action or uniform system. Hence good results, obtained in one locality, were of little or no benefit beyond that section of country. With no central authority or power to collect, preserve and disseminate facts, they were often lost. The different modes adopted in the societies to obtain the same object, failed to commend the societies favorably to the public. Their members were said to belong to "rings," who gave premiums according to favoritism, instead of merits of animals.

A few leading men who were in advance of the time, sought to make these societies more useful towards promoting the agricultural interests, by putting them on a basis where their acts would be more systematic and uniform ; by the establishment of a central Board of Agriculture, which should sustain similar relations to the agricultural societies, that the Board of Education did towards the common schools. Hence a call emanating from the trustees of the Norfolk Agricultural Society, Jan. 28, 1851, for a convention, composed of one delegate from each society, to meet at the State House in Boston, March 20, 1851, to concert measures for their mutual advantage and the promotion of agricultural education. This convention assembled at the time and place named, and, after thoroughly discussing the matters pertaining to the object of the meeting, an agricultural board was organized, composed of three delegates from each society. The discussions in this convention indexed the sentiments of the people towards agricultural education. While considering the following resolution, to wit, "That, inasmuch as agriculture is the chief occupation of her citizens, the Commonwealth, in the organization of its government, should be provided with a department of agriculture, with offices and honors commensurate with the importance of the duties to be discharged, of the abilities to be required and the labors to be performed," one of the delegates said : "This resolution squints towards a college. If it has that tendency, I shall be opposed to it ; for I do not believe that the farmers are prepared to spend money in instituting a college. I think it would do them no good whatever."

This voluntary organization was superseded by the establishing of the Board of Agriculture in 1852. Under its management new vigor has been infused into the societies, their power for usefulness strengthened, and their influence extended. The collecting and disseminating much useful information through these channels each year has reached the average farmer, and awakened in him a spirit of inquiry and improvement, and given a new impetus to agriculture.

There is considerable prejudice existing against the Board of Agriculture, at the present time, due in part to ignorance. Many believe, or affect to do so, that it is antagonistic to the agricultural societies of the State, failing to comprehend, or ignoring the fact, that it is a representative body, in which every society has a delegate. Every well-managed society has an executive committee, chosen from its members, to make regulations for its annual show and fair, and adopt all measures that they may deem necessary for the well-being of the society. Constituted as the Board of Agriculture is, it forms a very efficient executive committee for all of the societies. Its members, knowing the wants of the several societies, consult and advise as to rules and regulations for the benefit of all of them.

The rapid advancement in practical agriculture within the last decade is not all due to muscular strength and force, but largely to mind work, induced by the progressive elements surrounding the farmers. It has been said that "Out of the desire of a few individuals for an agricultural college, grew the Board of Agriculture." The "desire" for the college was certainly a very laudable one, and took fifteen or more years to educate the people to take an interest in it. It will be better appreciated as the people become more acquainted with its workings, and see the beneficial influence of a better agricultural education.

Andrew B. Dickinson, a farmer of the State of New York, who worked out his education by the light of a log fire, in his youthful days, in an address to a farmers' club in Chemung County, said that "it required more brain work to manage a well-equipped farm than to govern the United

States. The President can call to his assistance his chosen advisers, but the farmer, isolated and alone, must depend on himself." These sentiments, uttered a half-century ago, have much force at the present time. With exhausted soils, Western competition, scarcity of farm labor, narrow margin of farm profits, heavy real estate taxes, to grow and harvest the crops, feed and dispose of them the most profitably, care for the stock during the winter months, and economize labor pertaining to every branch of the farming, requires a large amount of study and calculation. It is true the Massachusetts farmer may call to his assistance the Agricultural College and Experiment Station, to develop science, which is power, whether applied to machinery or agriculture, to teach and explain its adaptations, which will aid him theoretically; yet, to apply this power successfully to practical agriculture, he will have to do a good deal of brain work.

With thirty-four societies, receiving bounty from the State, and that bounty being the main dependence of several of them for their support, and with the tendency to further increase the number, it is a subject worthy of consideration whether more additions can be made without impairing the usefulness of some already established. The division and increasing of school districts in the Commonwealth a few years ago, to make the schools more easy of access, in a few years worked the destruction of the district system. But, as a better school system was adopted, so perhaps in the near future some of the weaker agricultural societies may merge and consolidate their organizations, and good will result from so doing. Experience has pretty well demonstrated, that a territory of not less than twenty miles, extending either way from the central place where the show and fair is held, is necessary to sustain a society in a good, healthy, working condition. Societies start vigorously, flourish for a time, reach maturity as it were, remain stationary for a time, then begin to languish and decline. The society, instead of examining its management, to ascertain the cause of the diminished interest of the public, manifested by the non-attendance at the shows, resort to attractions foreign to the purposes for which the shows and fairs were instituted, which may meet perhaps with temporary success, but work disastrously to the society in the end.

The common idea and conception of our county agricultural fairs, originating more than a half-century ago, belong to another generation, another age and another condition of society. The surroundings of the show of that day have passed away, long ago. The successful society keeps pace with the progress of the day. Its management must be in accordance with the surrounding conditions of the time. On the show grounds, oxen in any considerable numbers in some localities are superseded by horses. The interest that the old time-honored ploughing match excited, now centres around the horse exhibition and poultry coops. In the exhibition hall, bedquilts, embroidery, fancy and crochet work, paintings and works of art, fill the places once occupied by the olden-time hand-spun and hand-woven fabrics. Fruits, vegetables and flowers, tastefully arranged, furnish attractions for multitudes. The horse, so valuable and useful an animal to man, always enlists a particular interest when on exhibition, whether for speed or in other classes. While societies should extend all proper, necessary encouragement towards this great and growing branch of industry, they ought not to allow the show and fair to degenerate into a mere horse trot and race, where the number of entries of fliers is the measure of attendance.

In some of the societies great improvement can and ought to be made in the system of judging and awarding premiums on stock. Committees are appointed nearly a year in advance of the show, who fail to attend or decline to serve, and their places are filled by selections from the crowd, without much regard to their qualifications, the main idea being to get some one to serve. Examinations are made and premiums awarded which are often unsatisfactory, not only to exhibitors, but to the public, which results in keeping from the exhibition a large number of first-class animals. If expert judges were selected outside of the society, their awards, being based on the merits of the animals, would give better satisfaction, and secure an increased interest on the part of the public.

The following criticisms, which are to the point, were published in one of the dailies recently: —

> There is room for considerable improvement in the matter of judging of stock at agricultural fairs, as everybody knows who has been either manager, exhibitor or spectator. Too often the judges are picked up on the spur of the moment, more because of their availability than their qualifications; too often the judges are biased for some animal, article or owner, and purposely nominated for these reasons; too often the inspections are carelessly made and hurried through as a mere matter of form; too often no reasons are given for the decision rendered, and thus the public, for whose benefit these fairs were instituted, are as much in the dark as aforetime. These things ought not so to be. The Commonwealth, on whose generous bounty many of the fairs feed, and the public, who freely pay their individual admission fees, have a right to all of the educational benefits.

Another practice, which prevails in several societies, of awarding premiums on grain products, without requiring statements in writing relating to the growing of the crop, ought to be discarded. The public take but little or no interest in the mere stating that A received seven dollars on the best five acres of corn, or that B received six dollars on the best four acres of oats. The statement that A and B received the same amount for the sale of the grain, would be of equal interest. If statements in writing were required, as to nature of soil, ploughing, cultivating, kind and quantity of fertilizer used, treatment of the land the preceding year, etc., to be published along with the transactions of the society, the information might benefit others. There is room also for improvement in the matter of farmers' institutes, which the societies are required to hold. These meetings in some sections of the State are thinly attended, and their utility not appreciated. If more practical farmers would attend and participate in the discussions, making them more practical, a much larger interest would soon be manifested, and a large amount of information be disseminated.

SOILS OF MASSACHUSETTS.

BY PROF. N. S. SHALER OF CAMBRIDGE.

Although the soils of Massachusetts belong altogether to the group which we may term exotic, — that is, where the materials composing them are not derived from the underlying rock, but are transported from a distance, — they exhibit a considerable range of phenomena, and are interesting both from a scientific and economic point of view. In the following account of the soils of this Commonwealth, I propose to consider first the origin and range of their character, and the relation of their characteristics to the geological history of the region; second, the relations of these deposits to the actions occurring during and after the glacial period; third, the present physical condition of these soils, and the economic aspects of the deposits.

The soils of Massachusetts, and indeed of all parts of New England, are of glacial origin. Practically the whole of the detrital material which composes them was rent from the bed rocks by the action of the ice sheet. Here and there the post-glacial decay has stripped small portions of the detritus from the underlying rocks, and commingled it with the soil. But these areas are in all cases insignificant in extent, and do not serve in any important way to qualify the character of the detrital materials which have been formed by glacial action.

Where soils are formed by glacial action, they differ essentially from those which are produced by ordinary agents of decay. Non-glacial soils, such as cover the larger portion of the earth's surface, are mainly formed by corrosive action, by the processes of chemical decay through which the foundation rocks of the country are taken to pieces and subjected to oxidation. The expanding action of frost and of roots which penetrate the bed rock may produce a certain amount of fragmental matter, which is commingled with the earthy material; but in all cases the larger part of the detritus which constitutes the soil owes its formation to the action of dissolving agents, among which we reckon ordinary carbonic acid and the various acids of the nitro-humic group. As these soils are essentially the product of plant action, the grains of which they are composed are to a very great extent commingled with decayed vegetable matter. This vegetable matter is most abundant in the upper soil; but, in the usual condition of the country, the roots commonly penetrate to the depth of some feet beneath the surface, and in their successive decay convey the humus into the deeper portions of the deposit. As the disruption of the bed rocks is mainly accomplished by the action of roots, it necessarily follows that the decayed plant materials penetrate the whole section of the soil. Though the quantity of such substances in the subsoil may not be great, it is still sufficient to affect the fitness of that layer for the uses of plant life.

In the soils which owe their origin to glacial wearing, the conditions are sharply contrasted with those which are formed by the action of vegetation. The material moved from the bed rocks by the ice is in most cases much more largely composed of coarse fragmental matter than in the case of the plant-made soils. In the former class of soils the process of disruption, accomplished by the ordinary agents of decay, divides the detritus into fine bits, and generally brings it into a state in which each grain is a chemical unit. In such soils, even if composed of the waste derived from crystalline rocks, each bit is made up altogether of one chemical substance. Thus, in such soils we find grains of quartz generally little dissolved, flakes of mica in an advanced state of decay, bits of hornblende or feldspar more or less affected by corrosion. Rarely indeed in soils of this nature do we find pebbles composed of these several minerals united in a solid mass. The result of corrosive decay is to separate in the grains of the soil the mineral constituents one from the other. In the case of glacial soils, however, for the reason that the division of the material is accomplished mainly if not altogether by mechanical energy, the resulting detritus is almost always composed of compound bits; that is, fragments having several minerals united together.

In ordinary glacial waste which has not been assorted by the action of water, the proportion of the coarse compound crystalline elements to the finely divided material is commonly very great; generally, indeed, the pebbles of a size to be visible to the naked eye constitute more than four-fifths of the mass, and they frequently much exceed this proportion. Not only was there an entire absence of vegetable matter during the accumulation of the glacial waste on the surface which it occupies, but the glacial waters were without carbonic acid gas, and therefore the chemical work accomplished during the ice term was small in quantity. We may fairly term the detritus which the glacial period left upon the surface an unnatural or pseudo-soil, — an earth coating, which has in no way been reconciled with the needs of vegetation; while the ordinary soil coating produced mainly by plant action constitutes the only real soil coating of the earth. It is only when the detrital material left by glacial action has become mixed with the vegetable waste, and to the extent to which the commingling takes place, that the material takes on a real soil character.

Although the glacial soils are not immediately derived from the subjacent rocks, but have always been more or less affected by transportative actions, there is in most cases a certain relation between neighboring rocks and the sheet of glacial detritus from which the soil is evolved. Thus the till or bowlder clay coating which is the commonest form of glacial deposit is generally composed of materials which have been derived from within five miles of the point now occupied by the detritus. At any given place the commingled clay, sand and pebbles usually represent something like an average of the mineral character exhibited by the bed rocks within that distance in the up-stream direction of glacial flow. Even a cursory examination of the New England soils will show the effect of this principle of transportation. Thus in the Connecticut valley the soils are mainly composed of detritus worn from the Triassic red sandstones of that region, and have the characteristic color proper to the beds from which the detritus has been taken. In the basin of the Narragansett coal field the bowlder clay has also the aspect determined by the general nature of the underlying carboniferous strata, and partakes of the dark color common to those beds. In regions where the bed rocks are silicious, the till is generally quartzose and infertile; where the bed rocks are of a limy nature, the materials of the soil are more fertile than elsewhere.

A yet further division in the character of the soils depends upon the peculiarities attending the action of the glacial envelope. When an ice sheet such as the last glacial period brought upon the surface of New England is in the fullness of its activity, it is constantly removing material from the surface over which it passes. This material is in part commingled with the ice, probably to the depth of some hundreds of feet above the bed rock, and is there borne on to the southward with the flow of the glacial stream. A small part held between the bed rocks and the ice is subject to constant and rapid mechanical abrasion, and is thus ground to powder. While this work of rending and pulverizing the rock is going on, the fine material as well as a portion of the pebbles is swept forward by the streams of water which from time to time flow between the ice sheet and the subjacent earth. In general these streams appear to have had no great depth, but to have been very extended in their action, occasionally sweeping away the quantity of the rock waste, and then ceasing for a long time to flow, permitting the debris to accumulate to a considerable depth. At other points beneath the ice the molten water was organized into distinct streams, which appear to have flowed in caverns excavated in the ice, moving forward towards the margins of the glacier in a furious and tumultuous manner, as we can imagine would be the case with water weighed upon by a thick coating of ice, and thus pushed forward to its point of escape. These streams pour out a vast amount of finely divided rock to the open sea, or to the open air on the margin of the continental glacier. Escaping from beneath the ice, the coarser particles quickly fell upon the surface of the land or upon the sea floor; while the finer mud, supported for a long time in the water of the rivers or tidal currents, was carried far from the margin of the ice field. Generally speaking, the clay escaped from the field of the ice action, and was borne away to the ocean floor or to the level plains, such as have accumulated about the mouth of the Mississippi. We find the only considerable remnant of the material borne out by the subglacial rivers in the sand plains, which are extensive developed deposits along the coast line of New England south of Maine, or across the face of the continent in front of the open ice margin, from the Atlantic Ocean to the far West.

These glacial sands, composed of the materials poured forth by the old rivers from beneath the ice, constitute a marked feature in the soils of Massachusetts. Beginning in the western margin of the State, we find traces of these deposits, as is shown in the general map, along the bottoms of the greater valleys, usually forming a narrow strip, extending from near the head waters of these streams to their confluence with the larger rivers. In these larger rivers the deposits are to a great extent continued; but they are in a considerable measure hidden by recent alluvial accumulations which have occurred in such places. In the Berkshire district, as we may term the hilly country west of the Connecticut, the proportion of the area occupied by these washed sands and gravels is small. It does not amount to more than one-tenth of the whole field, the remainder of the surface being covered by till materials, as we may term the unwashed waste of the ice time. East of the Connecticut the proportion of these sands and gravels greatly increases, until, in the section east of the meridian of Worcester, about three-fourths of the area is covered by these washed materials.

As will be readily noted by the observer, the greater part of the detrital matter composing these stratified gravels and sands is of a silicious nature. Generally, however, there is a certain admixture of pebbles of compound rocks, fragments containing a certain amount of lime, potash, soda and phosphatic material, which supply them in a small measure the materials necessary for the sustenance of plants. It is a well-known fact that pure quartz yields but little of the material necessary for plant growth. In our soils quartz has something of the same place in the general functions of the material which nitrogen has in the air. It is practically an inert substance, entering into but few combinations, but serving to dilute the other materials which compose the soil material. Plants will not develop in pure sand, any more than animals will breathe in pure nitrogen. On the other hand, a soil entirely destitute of silicious matter would be unfruitful, because of the excessive compactness which would thus characterize it.

There is a third condition of the soil in a glaciated field, which is due also to a peculiarity in the physical conditions of the last ice time. During the glacial period, the front or margin of the ice occupied a number of different positions. At one time this ice front was maintained for a considerable period, probably for some thousands of years, along the line beyond the margin of the main-land. It stretched from southern New Jersey across where now lies Long Island, N. Y., thence by the islands of Martha's Vineyard and the main-land of Cape Cod, extending farther to the northward across the gulf of Maine. At later stages in the decline of the great glacier, this front occupied for a less considerable period various positions farther in the interior of the country. Along the successive margins of the ice there were accumulated heaps of detritus known as frontal moraines. These frontal moraines are an extremely conspicuous feature across the greater part of the continent. They are characteristically shown on Long Island, N. Y., on Martha's Vineyard, Nantucket, and at other points in south-eastern Massachusetts. Similar deposits, indicating shorter periods of action, are traceable throughout Massachusetts from the Connecticut River to the sea.

These shoved moraines represent a very complicated series of actions. In part they are due to the fact that the ice, moving constantly forward, was melted, and passed into the state of water along the line of the glacial margin, and so dropped the detritus which had become mixed with its mass in the long journey over the bed rock. It is evident also that the front of the ice was not permanent, and it occasionally retreated a mile or two back from the wall of the moraine, and then, refreshed by a larger supply of snow, pushed forward, driving before it in the manner of a huge scraper a quantity of debris which was thrust up into the frontal moraine. At the same time, at various points from the ice front subglacial rivers were pouring forth, which scoured ways through the frontal moraine, and distributed vast amounts of sand and gravel in a stratified form, partly in the mass of the moraine, though in a larger measure over the fields lying immediately in front of the ice line. The result of this action is that the morainal masses of Massachusetts and other regions contain extremely varied soils. Here and there we find them so bowldery that there is no soil whatever. At other points we observe patches of soil material composed entirely of waste from the bed rocks in the immediate vicinity. Again, the material is ordinary till in its character, — sand and gravel and clay commingled with large bowlders in a perfectly confused manner. At other points there may be pockets of clay formed in quiet pools inclosed in the extremely compact mass of the moraine. Samples of characteristic morainal soils are afforded by the moraine of the north-western side of Martha's Vineyard, or that which extends through the Elizabeth Islands, and northward to near the village of Plymouth.

Yet another peculiarity of New England soils, due to the action of glaciation, is found in the exceeding thinness of the detrital coating over considerable areas, which, under the ordinary conditions of the earth, would be soil-covered. Owing to a variety of circumstances, the bed rocks beneath a glacier are at the end of an ice period sometimes left almost bare, while in the neighboring areas the bowlder clay may be extremely thick. At several points in Massachusetts I have observed within the limits of a square mile considerable areas nearly bare of detritus, bordering immediately on patches of the drift which were one hundred feet or more in thickness. Contrasts as sharp as these are rare; but over a large part of the State — indeed, of New England in general — we have a disposition of the drift so irregular as to give these frequent contrasts between detrital material thick enough to afford the foundation of good soils, and areas which are practically soilless. In some cases the absence of glacial waste which may afford the foundations of soil is due to the steepness of the slopes on which the detritus originally rested, but from which it has been removed by gravity, aided by the rains, the frost, and the shoving action of plant roots. In other cases the lack of detrital material is due to the scouring action of the subglacial streams, or to the fact that the detritus from soft rocks has been altogether ground to fine detritus by its contact with harder material, and washed away.

It not infrequently happens that the bed rock, when worn by a glacier, readily breaks, on account of its natural joints, into large fragments, while these fragments, in themselves of a tough nature, do not readily pass into the state of fine detritus. Under these conditions the surface may be covered by very large angular fragments, there being insufficient finely divided material to fill the spaces between them; and thus the soil covering may be practically wanting, or reduced to small patches crowded in the interspaces between the large erratics. An instance of this nature may be found in the "Dogtown Commons" of Cape Ann.

We shall now consider the process by which detritus, accumulated on a country by glacial action, forming pseudo-soil, may be converted into a real soil coating. In an ordinary soil, whether it be originally formed on the surface which it occupies, or whether it has been transported by the action of rivers and accumulated in the shape of alluvial plains, the process of disintegration of the rock goes on along with the growth of vegetable life; and the debris of a mineral sort is thoroughly commingled with the vegetable waste, and all parts of this waste are subject to the solvent action which is brought about by the decaying vegetable matter. In the case of river alluvium, the vegetable matter is commingled by the process of sedimentation with every part of the mass. In the case of soils which originate where they lie by the decay of the bed rocks, the breaking up of the under strata is to a great extent accomplished by the action of the plant roots, which penetrate into the rifts of the strata, enlarge and rupture the fragments, and gradually lift them to a higher level in the soil. In any forest-clad country the trees are frequently subjected to violent overturning, by which the soil is rudely inverted, somewhat in the manner in which that process is deliberately accomplished by the plough. The result is, that in general, in natural soils, in the course of long ages the vegetable matter penetrates through all the detrital material to which the roots of the plants may have access.

Taking any soil in the region south of the glacial belt, as, for instance, in the southern portion of the Ohio valley, we may generally assume that the process of commingling vegetable waste with the detritus has been going on for many geological periods. Such soils, indeed, commonly represent the work of many million years. In the glaciated districts, however, owing to the fact that the ice has passed away from their surfaces within a period of a few tens of thousands of years, this commingling of vegetable matter with the rocky material has been most imperfectly accomplished. In general, we may say that the relative duration of the time in which this work has been going on in unglaciated soils differs somewhat, in the proportion of one hundred to one. The result is, that the pseudo-soils of the glaciated district have not been subjected to the effective preparation for the uses of plant roots which has taken place in the soils of regions which have not recently escaped from the glacial envelope. It is doubtful if the glaciated soils of New England have been repossessed by vegetation, since the close of the glacial period, for more than a few thousand years. The time has been altogether insufficient for the adequate preparation of the glacial detritus for the best uses of plant life. The detrital matter is there, and generally in a state of division which favors the formation of the soil. This preparation of the soil coating is now going on in a geologically rapid manner; but it will be profitable to the tiller to recognize the fact that he can advance his interests by hastening the rate of the process of preparation.

In considering the needs of our soils in glaciated districts, we have to bear in mind two facts which have an important bearing on the economic problem which the farmer has before him. In the first place, scarcely any soils within the glaciated belt, except those of a swampy nature, have sufficient vegetable matter in their mass, say for the depth of a foot below the surface, to serve the needs of plant life. It is very desirable to increase this amount of vegetable waste as rapidly as possible, and to extend it to the depth of at least a foot below the surface. It is a well-known fact that the process by which the mineral matter is converted into the state in which it may serve for plant food is mainly effected by reactions, which depend upon the decay of carbonaceous or other organic material beneath the surface of the soil. A certain amount of work of this nature is done by the water, which obtains carbonic acid gas and nitro-humic acids from the surface, and passes them downward in its descent into the soil; but it seems pretty certain that the whole of the work cannot be accomplished in this manner, but is best attained by the actual commingling of decaying vegetable material with the mineral grains of the detritus. Therefore, in glacial districts generally even more than in soils of other character, it is desirable to plough in such crops as may fitly serve this end.

It should be observed, as before noted, that glacial soils are commonly composed in large proportion, generally to the extent of more than half of their bulk, of pebbles, containing a variety of mineral constituents. It is very desirable to promote the decay of these fragments, for from them there is a constant contribution of various valuable mineral elements, — lime, potash, soda, phosphatic matter, etc., — which are immediately necessary to plant growth. A pebble of granite rock, lying in the ordinary conditions in which it is deposited by glacial action, decays very slowly. If, however, it be enveloped in decomposing vegetable matter, the process of solution is rapidly advanced. A familiar instance of this may be perceived in the case of organic rocks which have been long buried in swamps. The reader may have observed, that, when these fragments are removed to the open air, they have a singularly white color; this hue is due to the decay or kaolinization of the feldspar, a process which aids in its solution in water. He will also observe that the outside of such stones is commonly very rotten, the surface readily falling to pieces by the friction from his hand. He may also have seen that around the margin of our erratics which project above the surface of the fields, there is commonly a fertile strip of land in which the crops or the natural vegetation grows more luxuriantly than elsewhere. In good part this fertility of the soil near the bowlder is due to the fact that the decayed matter removed from the surface of the stone is carried by the rain to its margin, and so contributes to the nutrition of plants.

The extent to which this increase in the fertility of the soil may be brought about by adding humus to its mass, will depend upon the measure in which the soil seizes upon the mineral substances, and uses them for plant food. In general, however, it may be said that the glacial soils of New England, even if apparently pure sand of a silicious nature, contain a sufficient amount of mica, feldspar and other minerals which afford nutritious matter by the action of humus in the mass; even the thoroughly washed sands of the sea-shore, which appear at first sight purely silicious, really contain a good deal of mineral matter which has a high nutritive value. Generally, however, the proportion of vegetable waste in these sandy soils is very small, and this for the reason that, being readily permeable by water, the vegetable matter is rapidly removed by decay, or leached away by the rains. Experience seems to show that ploughing in green crops greatly adds to the fertility of these soils, in the first place, by promoting the solution of the mineral matter; and, in the second place, by helping to contain water in seasons of drought. Every bit of decayed vegetable matter acts as a sponge, and yields a certain amount of moisture until it is completely disintegrated by decay. It may be here noted that experience shows that the seaweeds are particularly valuable in aiding the moisture-retaining capacity of the sandy soils; and this probably for the reason that they have more or less deliquescent salts in their composition, which readily retain moisture until they are dissolved and taken away by the ground water.

The most considerable difficulty in glacial soils arises from the general absence of a distinct subsoil. Usually these glaciated soils continue with the same character they have near the surface indefinitely downward to a depth far below the range of plant roots. In an ordinary or true soil there is almost invariably a definite under soil, which is tolerably impervious to moisture, and which retains the soil water near enough to the surface to protect the vegetation from droughts. Generally this subsoil lies at a level below the surface, determined by the penetration of the plant roots. The relative impermeability of this under soil tends to keep the valuable materials of the cultivated layer from penetrating downward beyond the reach of the plant roots. Where the glacial soil is composed largely of clay, as is often the case, the plough tends to form, by its well-known action, a packed layer which serves in a measure the functions of a natural under soil; but in the sandier districts no such compact layer can be formed, and the result is that the fertile material produced by the natural reaction of the plants on the mineral matter contributed to the soil by artificial fertilizing processes, quickly escapes from beyond the plant roots. The only way to meet this evil is by increasing the amount of vegetable matter in the tilled part of the earth. Peat from swamps, sea-weed, green crops ploughed in, all serve in a measure this same end of contributing to the soil absorbent agents, which may hold the fertile elements as in a sponge until they are availed of by the growing plants. Therefore we may, in a word, sum up the conditions of the treatment which should be applied to the pseudo-soils of our glacial districts as follows: the aim should be to advance the natural process of commingling vegetable matter with the detrital coating as rapidly as possible.

Considering in a general way the comparative merits of the soils in the glacial districts and those formed under the more general processes which produce the tilled stratum in non-glaciated districts, we observe that glacial soils differ from those of unglaciated districts in the fact that they do not wear out by tillage. In an ordinary soil, derived from the decay of the rocks immediately beneath the surface, the deposits contain within the depth of a foot or so a large store of plant food, which has been slowly accumulated during a great period in the past. This material is rapidly yielded to tillage, producing large crops at the outset, and generally less considerable returns with each succeeding year of cultivation. Save in rare cases, as in the blue-grass district of Kentucky, where the soil is immediately underlaid by soft fossiliferous limestone, which rapidly decays when stirred by the plough, such soils, save for artificial processes of fertilization, rapidly lose their crop-giving powers. On the other hand, the soils of the glaciated districts having no such harvest of plant food gathered during the geological ages, though they give less considerable returns than the natural soils, commonly maintain their productiveness, and grow steadfastly better under a rational system of tillage, even independent of ordinary manuring. The fact is, that these glaciated soils have in the pebbles which abound in them a constant source of refreshment and renewal, which has only properly to be made avail of to add to their fertility. Well commingled with vegetable matter, frequently stirred with the plough to promote the disintegration of the fertilizing bits, such soils, under reasonable treatment, may, though never very fertile, grow better for ages of tillage.

Even the neglect and maladministration of such soils does not usually bring the same amount of damage that it does to the earth in non-glaciated districts. It is almost impossible by injudicious cropping to exhaust what fertility may be in soils of glacial origin. A few years of fallow permits a sufficient accumulation of material decayed from the surface of the pebbles to afford a fresh supply of plant food.

Another advantage arising from the peculiar structure of glacial soils is, that they rarely wash away in the manner frequently observed in other more normal soils. Thus, while in Virginia, Kentucky, and the other States south of the glacial belt, large areas of what were tilled fields have been swept away with the streams, leaving either the bare rock or the subsoil, such devastation is never seen in glaciated districts. In a more extensive way, because of the more continued tillage, a large part of the once fertile lands of southern Europe have been reduced to the state of desert. The freedom from washing away, characteristic of glaciated soils, is primarily due to the fact that they have no subsoil. The ground water sinks freely into their depths, and gradually escapes by ill-defined springs to the drainage system of the country. The result is, that, whereas in Virginia and Kentucky somewhere near one-fifth of the total area has been seriously damaged by the superficial and temporary streams which have been formed during heavy rains, probably not one one-hundredth part of the tilled land in New England has suffered in a serious way from such accidents. Another advantage possessed by the glacial soils consists in the fact that, by proper tillage, the soil can be extended downward to any desirable depth. This is rarely the case in regions where the soils are produced by the decomposition of the rocks immediately beneath which they lie. The subsoil in such countries is frequently so compact that it cannot readily be incorporated with the true soil without great cost in the process of manipulation. Last of all, we may note the fact that in glaciated districts the soil on a given area, such as is occupied by an ordinary farm, commonly contains a far greater variety in the character of the fields than occurs where the soil originates by the decay of the subjacent rocks.

In most of New England farms of say one hundred acres in area, there are usually fields of tough clay, those of a sandy character, patches of bog land which yield peat for fertilizing purposes, and varied sites for the cultivation of those crops which demand a large amount of moisture. Thus the farm of the New England district is commonly more self-supporting than that of a region characterized by normal soils. This variety in the employment of the farmer who tills glacially formed soils is not to be reckoned of small account in estimating the advantages of his position. The more varied the occupations of the agriculturist, the larger the share of educational effect which arises from his occupation, as compared with the life of the cotton planter or the grain dealer of more fertile districts. In place of winning subsistence from a single crop, the New England farmer commonly markets at least half-a-dozen soil products. He has the experience of the dairyman, of the cattle breeder, fruit raiser, and perhaps of the market gardener; and in this varied employment he finds opportunities for intellectual development which are denied to those who depend on a narrower range of soil industries.

CHOOSING AN OCCUPATION.

BY J. HENRY GODDARD OF BARRE.

When, one year ago, my excellent but now lamented friend, Dr. Lynde, secured from me a promise to prepare a paper for this meeting of the Board, it was required that a topic should be selected, so that the announcement might be duly made in the Secretary's report; and so, without much reflection, I said, let it be, "Choosing an Occupation." But, when it came to writing the essay, the topic seemed to be not well chosen. However, let it stand.

Another thing: it occurred to me that the members of this Board, having presumably already chosen their occupations, are not likely to be directly interested in the subject of my paper. Yet I hope they all have, or may have, sons or grandsons who are to be fitted for useful and honorable citizenship. And the customs of the past lead me to hope that the suggestions herein contained may yet reach a much larger and more varied hearing.

What *is* an occupation?

Webster defines it as "that which occupies or engages the time and attention; the principal business of one's life." Accepting this definition in all the force of its meaning, with what importance does it invest our topic, and with what care and solicitude should the choice of an occupation be attended.

That the highest good and greatest happiness of the human race imperatively demand that regular employment be furnished its members, will, I think, be conceded by all. There are various reasons, in different cases, why this is true. The rich need it for its moral benefits, and for the security it furnishes against all those evils which result from luxurious indolence. The poor must have it as a means of supporting existence; but beyond and far above this, they need it, like their rich neighbors, for its influence on their moral and social natures. But, whether rich or poor, all need to be seasonably educated in some useful and respectable calling; because fire, flood or fraud may suddenly and radically change the conditions of life, and render a remunerative occupation a matter of practical necessity to the individual existence, as well as a blessing to the moral nature. Under such circumstances, how many men have been saved from poverty and its attendant evils, and even from a suicide's fate, by possessing the knowledge and skill of an artisan, which enabled them to battle successfully against the financial misfortunes which had overtaken them.

Recognizing, then, the controlling influence which "the principal business of one's life" must exert upon the character and destiny, as well as the necessity of its possession, how important it seems that the selection of an occupation should receive the most careful attention. And yet how few young men fully realize what a factor the decision of this question is to be in all that will go to make up the sum of success or failure in life; in fact, in many cases it may be said with truth to constitute all the difference between those conditions.

Probably not more than one man in ten, on an average, can truly be said to have *chosen* his occupation. It may have come to him as if by chance; or, to speak more correctly, circumstances have changed the course of his life, and led him to adopt a vocation for which he either had no natural inclination, or for which he had never believed he possessed the requisite talents. It has been foisted upon him, and after a time he has, perhaps, discovered that he was "building better than he knew," and the result proves satisfactory.

Sometimes a young man is brought up and educated in the profession or vocation of his father, and a noted business house is perpetuated through several generations in the same family. But I think such instances are to be regarded as exceptional, rather than the rule. We generally think our own occupation less desirable than some other; we have found the objections that lie against it, and have too lightly esteemed or entirely overlooked the advantages peculiar to it; while we have seen all the apparent good points in our neighbor's calling, and wholly failed to note the objections to which it may be and doubtless is liable. And so, often, we do not foster, if we do not actually discourage, any inclination or desire of our sons to follow the occupation which has proved so irksome, although perhaps reasonably successful, to their fathers.

In choosing an occupation, perhaps the first question that will arise in most minds is, Which will be most likely to yield the best financial results? This is manifestly a point of prime importance; but there are risks of competition and speculation to be encountered in some occupations, to which others are not liable to the same extent. You are traveling towards a certain place; you arrive at a point where the road divides; one route is shorter and less rugged than the other, but crosses a river by a bridge which is defective and believed to be unsafe, while the other road is free from that danger. It is manifestly the part of prudence to take the safe though longer road. In Wall Street fortunes are sometimes made in a single day, it is said. But is it not equally true that they are often lost in as short a time? The wise man said, "He that hasteth to be rich hath an evil eye, and considereth not that he shall come to poverty."

Other questions of importance will come up, as, Is the occupation proposed one that will conduce to health and good morals? Will it open the way to honorable distinction and preferment? These must be answered carefully, in the light of the good judgment and experience of others, of whom the young man seeking a vocation should take counsel. But just here is the point where many young persons make a serious mistake. Youth is full of hope and anticipation; everything in prospect is of rosy hue, and invested with all the enchantments of joyous expectation. In her "bright lexicon there is no such word as fail." The healthful youth is full of life and energy, seeing only the bright side of the future, and reaching forward with eager haste to grasp the prize which appears so easy to secure, and refusing to believe that there is any possibility that it can elude his grasp. Here, I say, is often the fatal mistake of a lifetime. Young man, take counsel of your elders. They have traveled over the way upon which you are about to enter. They know where some of the enemy's batteries are masked, where some of the pitfalls and other dangers are concealed, because they have traversed some of these paths before you, and hence are able to give advice founded upon experience. Listen attentively to this advice. Ponder it thoughtfully, weigh it carefully; and, having marked out your course, enter upon it with firmness, and a determined purpose to achieve success.

Here, also, I am obliged to admit that parents sometimes make a mistake equally fatal, by insisting on a certain course in life which they have mapped out for their sons. Advice and counsel they ought certainly to give, re-enforced by lessons drawn from experience and intensified by parental love and solicitude. But all this should stop short of the very appearance of threats or commands. The young man is to be the builder of his fortune; let him then also be its architect, with such suggestions as your experience and knowledge of the elements and materials which must enter into the structure will enable you to furnish. The period of life when the young man is completing the theoretical and entering upon the practical preparation for his life work is most important and critical. In seeking to give him counsel and advice as to his course, therefore, the utmost care should be used to lead him aright. I say *lead*, because you *must* do that if you would influence him for his own good. In order to do this, several things will be necessary: you must possess his confidence and respect; you must thoroughly understand his capacities and temperament; he must be made to feel that your words of counsel are the outcome of a sincere desire for his highest benefit. He will doubtless invest the future with very bright colors, and your experience of practical life may cause you to feel that the picture is misleading. But beware how you cast darkening shadows upon it. Seek, rather, to show him how he may improve it by shading down and softening the view, so that the transition from the ideal to the actual shall be rendered easy and natural. If the occupation which seems to you to be the best for your son, and to which he appears to incline, is one which requires long and laborious preparation, or is environed by unusual difficulties, do not try to hide or depreciate those objections; rather encourage him to put forth effort and energy, in order that he may overcome all obstacles, and compel success. So will your son, in the very effort of settling the question of his occupation, receive a lesson in mental discipline which will materially help to prepare him for the actual battles of life which are just before him.

In approaching the choice of an occupation, the young man is at once confronted by an "embarrassment of riches."

The doors opening before him are so many, and the hands beckoning him on so numerous, that he is confused. While these occupations may be divided into few grand divisions, as, the professions, agriculture, mechanics, arts, commerce, etc., their subdivisions are numerous; but most of them are honorable when well filled, and the young man who aspires to enter any one of them should be conscious of a determined purpose to so fully qualify himself for his work, and to so well and successfully perform it, that he will prove an honor to the occupation of his choice.

But very important changes have taken place within the past forty years, as to the facilities afforded youth for acquiring the theoretical as well as the practical knowledge needed as a preparation for the active duties of mature life. Then one graduated from the district school, where he was now at the head and again at the foot of his class; but that depended generally on whether the record was taken Saturday night or Monday morning. Now the farmer's boy has the benefit of the high school and the agricultural college, with all the advantages suggested by this contrast. Then the lad served an apprenticeship of three or more years at some trade, and learned the rudiments, at least, of all branches of that trade; and it was not very easy, for one who had not served out his time, to obtain employment in any other respectable establishment of the same trade. Now the young man, after a few months of service, leaves his employer and sets up business for himself, as an amateur. Or, if he remains, and is diligent and faithful in his duties to the end of his term, he will perhaps have been able to learn only one branch of the business; because most of the trades are now so subdivided into departments, that while, for example, he may have learned how to cut or put together the upper part of a shoe, he may not be able to put on the sole, or to be sure, when some other one has done it, whether or not it is properly done. And the same is substantially true of many other trades. When I was a little boy, my father dressed his own beef and veal and mutton; he took the hides to the tanner and had them made into leather; then the shoe-maker came with his "kit" and made and repaired the shoes for the family. And a little before my recollection a similar process represented the production and preparation of the woollen and linen fabrics required for the comfort of the household. Now, how all this is changed. The shoe-maker with his lapstone, and the tailoress with her measuring-tape, have been crowded to the wall; and our clothing and foot-wear are manufactured at wholesale, and dealt out to us by sizes and numbers, and are even sent to us through the mails. What is to be the ultimate result of these changes remains for the future to disclose. What seems important for us to do, is to recognize the fact that progress is the inevitable order of things, and so shape our course and trim our sails that we shall be prepared to avoid the dangers and secure the advantages of the forces which are active about us.

Without controversy, success in the learned professions requires a high order of intellectual endowment. But the idea that the stupid boy would do well enough for a farmer (if indeed such folly was ever believed), has long since given place to better common sense; and, while it is freely admitted that each class of occupations requires certain natural endowments of a high grade, in order to render possible the highest success, it is still true that the successful farmer of to-day and of the future must have brain as well as brawn.

But there are so many kinds as well as grades of intellectual endowment, that there need be no apprehension but that each of the occupations can receive its due share, if only the raw material can be properly distributed. And here the responsibility of the distribution is thrown back upon the young men who are seeking for occupation. It has been said to be impossible to construct "a silk purse from a sow's ear." But, if you are not adapted by nature to become a successful lawyer, you may make an excellent blacksmith. You might prove a failure as a preacher, and yet make a successful farmer. But that would not prove that the mental requirements of the farmer's avocation are greater than those of the latter. It might, perhaps, be more properly styled the adaptation of means to an end.

It is not my purpose — in fact, it would be presumptuous — to undertake to point to any particular occupation as preferable to others. There are golden as well as honorable possibilities in most of them, waiting to be improved by the young men and boys now coming and to come upon the stage of active life; and it remains for them to study their own capabilities and measure their own ambition, with that care and shrewdness which will enable them to make a wise choice. And it is to this end that I would aid them, so far as may be possible.

The desire to secure a large fortune I consider a laudable one; but the means to be employed must be free from avarice and all miserly love of gain for its own sake; for, while "the love of money is the root of all evil," money itself is a blessing, for almost every material good may be purchased therewith. "If riches increase, set not thy heart upon them." This wise admonition does not carry with it the inference that the increase of riches is not a commendable object of desire. Some one has condensed a great deal of truth into a few lines, as follows: "There is a burden of care in getting riches, fear in keeping them, temptation in using them, guilt in abusing them, sorrow in losing them, and a burden of account at last to be given up concerning them."

That class of occupations represented by the largest number of millionaires, will, I think be found to involve the greatest risks and the most anxiety, while the slow and steady gains secured by the mechanic and farmer are liable to those objections only in a comparatively small degree.

The learned professions are no doubt crowded, but there is still "plenty of room at the top," and the young man with good health and a well-balanced head, still has the possibility of forcing his way up the ladder, step by step, to that broad and fruitful field, where such harvests of honor and distinction have been and are waiting to be reaped. In commercial life, where the greatest fortunes are secured, as already intimated, will be encountered, not only the greatest risks, but the most wearing labor and insidious temptations. Consider well whether you are able and willing to grapple with these for the hope of the golden prize which surely lies beyond, but which may, after all your care and energy, elude your grasp.

Already I have intimated my belief that agricultural occupations, while they do not hold out the offer of great or rapid pecuniary gains, are liable to less objections than most others. And I am willing to go on record as saying that I believe that farming as a business will continue to grow in importance, notably in New England, during the coming century; and that, when the little boy of to-day becomes "old and gray-headed," there will be no need to organize companies to provide for reclaiming the "abandoned farms," for there will then be no such thing heard of here. Rather will the Western farmer be returning from his worn-out farm to seek a better one in the East. My regret is that *we* shall not live to witness the full fruition of this prediction.

A great many essays and editorials have been written with a view to answering the question, "How to keep the boys on the farm," as though that was a consummation to be desired. I would not keep them *all* there, certainly not if there were as many sons in the family as there used to be fifty years ago. But, where a farmer has but one son, he may be pardoned for making an extra effort to retain him upon the farm. My father had five: one entered a profession, one remained on the farm, two were mechanics, and one was a printer and journalist, but is now a farmer. Perhaps that was a fair division. No, I do not think all farmers' sons should become farmers, because, in that case, what would the learned professions do for bright boys to keep their ranks filled? Or what could these professional gentlemen do with their best stock, if the farmer's vocation was not open to them?

While, as already admitted, the gains from agricultural pursuits are slow, they are, I think, more certain than in those callings where the " profit and loss account" is greater. It was stated by the senior member of this Board, in his able paper a year ago, that, of all cases of insolvent debtors returned to the office of the Secretary of this Commonwealth during ten years, only about one-fifth of one per cent were farmers. Everybody knows how the receipt of large but irregular profits tends to extravagance in expenditure, while the slow but steady gains of the farmer rather encourage economy, which, if practiced in connection with wisely directed industry, will generally bring success in any calling. It is the money *saved*, rather than that *earned*, which makes a man rich. And yet I would not have this maxim pressed too far. Provide generously for the comfort and education of your household, and be liberal and public-spirited as a citizen; but do not waste your income upon needless and hurtful indulgences.

Having chosen your occupation, commence at once, with a determined purpose, your thorough preparation for it. Make yourself familiar with the principles which underlie it. Learn all you can from books bearing upon the subject, and especially from the experience of those who have become eminent and successful in it. Cultivate perseverance, and do not be discouraged by difficulties, for these you must expect to meet, not only in the outset, but all through life.

Be self-reliant. You are to enter into a hand-to-hand conflict with the obstacles and hindrances of business life; with over-reaching dishonesty and honorable competition, the allurements of vice and the temptations to indolent ease. But remember that " success is a duty," and determine to win it, although the circumstances which surround you may seem adverse. Take heart from the words of the poet: —

> " How small, of all that human hearts endure,
> That part which laws or kings can cause or cure;
> Still, to ourselves, in every place confined,
> Our own felicity we make or find."

One or two points more I would urge upon the young man who is about entering upon his life work. He should become thoroughly acquainted with his business in all its branches and ramifications, otherwise he will surely be outrun by competition, and imposed upon by his employees. Let him give careful and unremitting attention to the details of his business. He must watch for and prevent the small leaks, as well as the larger wastes, if he would be successful. Take care of the cents, and the dollars will be secure.

No man has a right to expect his business will be successful unless he gives it his personal attention; and in no occupation is this rule more imperative than in farming. "The best fertilizer for the farm is the owner's foot-prints in the soil." But, while the young man entering business must be thus primarily devoted to his individual interest, let him remember that he is an integral part of the body politic, and that the public good is identical with his own. "He serves himself best who serves his country well." And so let him be public-spirited, ready to do his full share in securing the highest welfare of his town, and not forgetful of those social and neighborly courtesies which form such potent factors in the promotion of good order and happiness in a community.

But it sometimes happens that, after a man has well entered upon his occupation, it may be after several years of fair success, he finds some things unpleasant, and imagines he could do better in some other business; and so he sells out, and embarks in a new enterprise. Of course, I am ready to admit that there are cases, involving such paramount considerations as health, or social and educational advantages for one's family, which might justify such a course. But, as a general rule, I think it will be found better to stick to one's business, and put forth increased efforts to overcome the difficulties and improve the circumstances which exist. He should remember that the older he grows the less able is he to commence anew the battle of life; and while, had he chosen in the outset the avocation which he now proposes to take up, he might perhaps have achieved a more decided success, it will, I think, generally be better for his combined interests not to make the change.

Neither should he be in haste to retire from business. If he has secured a competence, let him indeed relieve himself of a portion of his care and hard labor, as years advance, affording himself and his family increased ease and comfort, and seek opportunities for improving the condition of the community in which he dwells. If he has become rich, it will now be comparatively easy to add to his millions, and there are plenty of opportunities to do good with his surplus. It need not be to him so dangerous an element as politicians would have us believe it is in our country's affairs. But generally the man who has passed the meridian line of life in active business, will be happier and live longer if he continues to have some regular occupation, than were he to spend his time in luxurious idleness.

These considerations in regard to "the principal business of one's life," crude and incoherent though they may be, are submitted with the hope that at least one little seed from among a mass of chaff may find its way into a congenial soil, and ultimately yield its appropriate fruit; and, if so, I shall be content.

And now, gentlemen, as the term of my connection with this Board is closing, I hope I may be pardoned for indulging in a few personal reflections suggested by the situation. I well remember, when I first sat in this hall, six years ago, the profound respect with which I regarded the venerable senior members of this Board then present. Among these were Wilder, Grinnell, Lane, Moore, Nichols, Slade. And I also remember one other gentleman, less venerable in years, but greatly beloved by us all, and a dear personal friend of my own, who, only a few days ago, was actively engaged in alleviating the pains and healing the ailments of humanity, — Dr. Lynde. I have thus directly alluded to seven distinguished members of this Board at the time referred to. We can rejoice, to-day, that one of these, having obtained mercy, continues to this time, and has the privilege of exchanging the fickleness of our Northern climate for the genial warmth of the sunny South, under the influence of which we hope he will be so recuperated in health and vitality as to continue yet many years the honored father of this Board. But where are the six?

They dropped out one by one. We let fall the tear of sorrow for the loss of their wise counsels and genial companionships; their places are filled by others who also win our love and respect; and with hearts softened by tender memories, but with purposes strengthened by noble examples, we turn again to take up the ever-present duties of life, and the onflowing current of our daily existence closes with a ripple over the breach, and we are borne swiftly along.

Very few opportunities of my life have given me more enjoyment than those which have brought me into an acquaintance with the members now past and present of this honorable Board. From them and from their secretary, past as well as present, I have experienced many acts of courtesy which will be cherished among the choicest memories of my life.

But, while we remember those venerable associates who have passed on before us, we must not forget that many of us who remain have already passed the meridian line, and soon our places in life will all have been filled by others. But let us—

> "So live that when our summons comes to join
> The innumerable caravan which moves
> To that mysterious realm, where each shall take
> His chamber in the silent halls of death,
> We go not, like the quarry slave at night,
> Scourged to his dungeon, but, sustained and soothed
> By an unfaltering trust, approach the grave
> Like one who wraps the drapery of his couch
> About him, and lies down to pleasant dreams."

TUBERCULOSIS.

BY DR. WILLIAM HOLBROOK OF PALMER.

The history of tubercle runs back through the ages. Isocrates, who lived in the fifth century before Christ, and shortly preceded or was contemporary with Hippocrates, who was called the "father of medicine," taught that consumption was a contagious disease, but he had few followers in his belief; while Hippocrates, in his book, discoursed on phthisis as an epidemic, believing the disease to be due to a certain condition of the air, and evidently did not consider it communicable from man to man, man to animals, or animals to man, by contact or association. It was rather a quality of the atmosphere or the breezes that affected the people, than germs of the disease; and his opinion prevailed, or his theory was accepted, for many years. We find thus early that doctors failed to agree in regard to disease, and have ofttimes since; or that there are two sides to questions, each expressing honest opinions.

What is a tubercle? It is a tumor in the substance of an organ, from the production of new matter. In pathological anatomy, the term is generally given to a species of degeneration which consists of an opaque matter of a pale yellow color. This in its crude condition has a consistence analogous to that of concrete albumen, and subsequently becomes soft and friable, and gradually acquires a consistence analogous to that of pus. Tubercles may develop in different parts of the body, but most frequently in the lungs and one of the coverings of the bowels. Laennec classes tubercles among the accidental tissues, which never exist except in consequence of morbid action; while others consider them as a scrofulous degeneration.

From the earliest days of the medical profession the sad fact has been recognized that, when consumption resulting from this tubercular deposit has become fully established in the substance of the lungs, or lung tissue has been destroyed, recovery seldom takes place. Many and in fact most of them died, said Hippocrates; and all of us who have practiced medicine are compelled in truth to say the same thing. For twenty-four hundred years, and probably through all the ages, the best medical minds the world has ever produced have coped with this disease; and yet, with all their studies and the accumulated wisdom of them all, about one-seventh of all the deaths that occur in the human family yearly are to be attributed to it. There is not a clime nor a period of life in which it may not be found; the rich and the poor, the civilized and the uncivilized, become its prey; and, since it cannot be cured, can we reduce the number of its victims, and how can it be done?

Tuberculosis is the specific infectious disease produced by tubercles, which are in turn special products of a distinct micro-organism known as the *Bacillus tuberculosis;* evidence incontrovertible shows that they are products of this distinct bacteria. Though the word tubercle is as old as anatomy, the term tuberculosis, in designation of a definite disease, is modern, comparatively.

The history of tuberculosis falls naturally into five periods: The first, that of ancient history. The second, beginning with the birth of anatomy in the sixteenth century, furnishing the first definite knowledge regarding changes or lesions of structure. The third was in the first quarter of the nineteenth century, following the discoveries of Laennec and Bailey, made memorable by the discovery of auscultation as a means of diagnosis. It was the genius of Laennec in this discovery which first rendered possible a diagnosis of this disease in life. The fourth was introduced late in the last half of the nineteenth century, with the inoculating experiments of Villemin in 1865. The fifth period was announced with the brilliant revelations of Koch in 1882, regarding the cause of tubercle and the etiology of disease. It is to the two latter periods that your attention is more particularly called.

The alarming prevalence, the obscure origin and the almost invariable fatal termination of tuberculosis, render a better knowledge of the disease most desirable. The records of the investigations relating to this subject, at the present time are scattered everywhere through medical literature, especially in periodical journals; and we can see the importance of the subject, when we find it stated on good authority that tuberculosis causes one-seventh of the mortality, and, if children and old people are excluded, from one-third to one-fourth of the death rate of the whole population. ("British Medical Times and Gazette.")

Does this disease exist in animals, and is it as prevalent as in the human family? I here insert a few statements from the "Springfield Republican," of Oct. 13, 1889. It says: The French congress, held last year for the study of tuberculosis, decided that it was as prevalent among cattle as among human beings; and, in Paris alone, 11,592 out of 50,825 of the people died of tubercular disease in 1888 (about one-fourth). It may be new to some, that the bacilli are found in cattle, both in the meat (although apparently undiscovered) and in milk, which, being fed to other animals, has been followed by consumption; and it states also that a metropolitan meat inspector in London testified that eighty per cent of the meat sent to market had tubercular disease, and the fact that the use of this diseased meat for food could transmit consumption to man was so clear as to make it dangerous to permit the sale of such meat. As to the milk of tuberculous cows, this same congress came to the unanimous conclusion that there was positive danger in the use of the milk of these infected cows. It used to be thought that the mammary glands should be subject to or have the disease, no matter what the conditions of the other organs were, to make the milk positively harmful. Experiments and observations at the present day prove that this opinion is erroneous.

No event in the history of the investigation of this disease has attracted the attention so universally and with so much interest as did the announcement of Dr. Koch in 1882. In his "Etiology of Tuberculosis" are these expressions: "Since by far the greatest number of cases of tuberculosis begin in the lungs, it is to be supposed that the infection in all these cases has taken place in the manner suggested, — by the inhalation of phthisic sputum dried and made into dust. The second principal source for the tubercle-bacilli — viz., tuberculosis of the domestic animals — appears not to have anything like the importance of the phthisic sputum. The animals, as is well known, produce no sputum, so that during their life no tubercle-bacilli get from them into the outer world by means of the respiratory passages. Also in the excrement of tuberculous animals the bacilli appear to be only exceptionally present. On the contrary, it is a fact that the milk of tuberculous animals can cause infection. With the exception of this one way, therefore (*i. e.*, through milk), the tuberculous virus can only have effect after the death of the animal, and can only cause infection by the eating of the meat. The same conditions hold for the milk of cows suffering from 'perlsucht.' Before all things, if infection is to take place, it is necessary that the milk contain tubercle-bacilli; but this appears to be the case only when the milk-glands themselves are affected with the disease." These were the opinions of Dr. Koch in 1882 (opinions, experiments and observations of other scientists will appear further on in this paper). If infection from tuberculous animals does not appear to be frequent, it must by no means be underrated.

In the statistics presented by Dr. Brush before the New York Academy of Medicine, April, 1889, he says * that, after close study for several years of the affection, including a consideration of all accessible statistics, and the habits of the people among whom it prevails, he has arrived at the conclusion that the only constantly associated factor is found in the in-bred bovine species. In the discussions that followed the paper, and the objections raised, Dr. Brush said that he believed that the disease was originally derived from the bovine species, and that not less than fifty per cent of all dairy cattle were affected with it; and, as to the connection with the human species, statistics showed that, wherever there was a race of people without cattle, phthisis or tuberculosis was not known.

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* Boston "Medical and Surgical Journal," cxx., p. 467 *et seq.*

Statements like the above (if true) are alarming to us all; a revelation to practitioners of medicine, a danger that has not been realized. It has been known by some scientific men, who have made the subject a study before Koch's revelations in 1882, that the consumption of milk from tuberculous cows was full of danger to those using it. I quote a case directly to the point.* In a paper read in Washington by Dr. Ernst of Boston a short time since, on "Tuberculosis and Cows' Milk," and how long it could be used without danger, is a quotation from a letter of a veterinary surgeon in practice in Providence, R. I. He says: —

> Mr W., June 15, 1878, called me to see a white and red cow. Coughs, and is short of breath and wheezes. Pulse, 60; respiration, 14, and heavy at the flanks; temperature, 104°. Diminished resonance of right lung, but increased in part of the same. Emphysematous crackling over left lung, and dulness on percussion. Diagnosed a case of tuberculosis, and advised the destruction of the animal.
>
> *December 12.* — Cow in a cold rain a few days ago for about two hours. Milk still more diminished than at a visit made on September 25. Again advised the destruction of the cow. Family still using the milk. Respiration, 20; pulse, 85; temperature, 104.6°.
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> *Feb. 22, 1879.* — Temperature, 104.8°; respiration, 26; pulse, 68. Losing flesh fast. Milk still in small quantities. Advised, as before, to destroy the animal, and *not to use the milk.*
>
> *May 30.* — Called in a hurry to see cow. Is now as poor as could be. No milk for a week. Pulse, 80; respiration, 40; temperature, 106°. The cow died in about three hours. Autopsy made fourteen hours after death: Lungs infiltrated with tuberculous deposit. Weight of thoracic viscera, 43.5 pounds. Tuberculous deposits found in mediastinum, in the muscular tissues, and in the mesentery, spleen, kidneys, udder, intestines, pleura, and one deposit on the tongue. The inside of the trachea was covered with small tubercles.

Now we come to the result of using the milk, it being used to within one week of the death of the cow.

> In August, 1879, the baby was taken sick, and died in about seven weeks. On post-mortem of the child, there was found meningeal tuberculosis, — deposits all over the coverings of the

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* "The American Journal of the Medical Sciences," November, 1889.

brain, and some in the lung. In 1881 a child about three years old, died with, as it was called, tuberculous bronchitis; and in 1886, a boy, nine years old, who for three or four years had been delicate, died with consumption, — "quick," as it was called. So far as known, the family on both sides have never before had any trouble of the kind, and the parents were both rugged and healthy people, and so were the grandparents.

The veterinary surgeon was laughed at when first called, and gave the advice to kill the cow and stop using the milk. Perhaps no one can say positively that using this milk was the cause of the deaths — the primary cause; but, by the light of the investigations of the last ten years, it surely points that way. You will observe that this occurred four years before Koch's discovery.

In the paper read before the American physicians by Dr. Ernst, he discusses the question, and believes that it is not necessary that the udder should show tubercular disease or deposit to show the bacilli in the milk; and he proves this beyond a doubt in the many experiments along this line. Koch asserts that the milk from cows affected with tuberculosis is dangerous only when the udder is involved, and his great name has caused many to believe his theory. Galtier, in giving the result of certain experiments with milk coming from tuberculous cows, says "the milk should be considered dangerous which comes from any animal affected, or suspected of being affected, with tuberculosis." Hirschberger reports the results of an experimental research upon the infectiousness of the milk of tuberculous cows, in which, following out Bollinger's work, he attempts to settle, first, whether the cases are rare in which tuberculous cows give an infectious milk; and, second, whether the milk is infectious only in cows with general tuberculosis, or whether it is also infectious when the disease is localized. He made the trials of the infected milk by injection into the abdominal cavity of guinea-pigs, with the usual precautions. His results were as follows: —

1. Milk was used five times from cows affected with a very high degree of general tuberculosis in all the organs.

2. Milk was used six times from cows with only a moderate degree of disease.

3. Milk was used nine times from cows in which the disease was localized in the lung.

From these twenty cases the milk was proven to be infectious in eleven. The percentage of positive results, when arranged in accordance with the three groups above given, was eighty per cent in the first group (milk from cows in a very advanced stage of the disease), sixty-six per cent in the second group, and thirty-three per cent in the third.

Experiments more interesting still, and more conclusive, have been made by Dr. Ernst, and directly under his own eye, in the bacteriological laboratory of the Harvard Medical School; while the feeding experiments have been made, and the experimental animals have been kept, upon a farm in the country, expressly prepared for this special purpose, and have extended over quite a long period of time and been attended with the utmost care. Full notes of these experiments will be found in the "Transactions of the Association of American Physicians," vol. IV., 1889. Dr. Ernst says the results enumerated "are, to a certain extent, preliminary; that is to say, they are but part of the work upon this subject which is being done under the auspices of the Massachusetts Society for the Promotion of Agriculture. The work will not be completed, at any rate, until next year. They show, however, first, and emphatically, that the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease; second, that the virus is present, whether there is disease of the udder or not; third, that there is no ground for the assertion that there must be a lesion of the udder before the milk can contain the infection of tuberculosis; fourth, that, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis, but with no discoverable lesion of the udder."

Is tuberculosis contagious, or is it not? It must be either one or the other. Such diseases as small-pox, measles, scarlet-fever and diphtheria are universally accepted as such; and the same reasoning which has led the general public as well as the profession to that conclusion, if the facts are the same, ought to bring them to the same conclusion in regard to tuberculosis.

Dr. Morgagni, a celebrated Italian physician, more than a century ago claimed that the virulent matter contained in the expired air of a consumptive patient was very infectious, and liable to transmit the malady by inhalation ; and he claimed this from his own observations, yet he was generally disbelieved. Recent demonstrations and experiments by Dr. Tappenia, who caused animals to inhale fine tuberculous matter which had been evaporated and thrown into a room by a steam atomizer, showed that ninety per cent of all the puppies confined therein from twenty-five to forty days showed well-marked miliary tubercles in both lungs ; thus demonstrating, in a very conclusive manner, that the bacillus germs may be borne by the breath, and may become exceedingly dangerous. In the "Brooklyn Medical Journal," of December, 1889, Cornet writes of certain experiments made upon animals with the dust from the walls of the rooms occupied by tuberculous patients. With this dust in sterilized broth, he injected the peritoneal cavities of healthy animals. All of these animals died in course of time with typical bacillus tuberculosis. The dust used was obtained from walls in hospital wards, and from walls of rooms in private houses. The bacilli in the dust came from the dried and powdered sputum ; and he emphasizes the statement that direct or indirect contact with the mouth of a tuberculous phthisical person should be avoided.

A case directly to this point : a German midwife, who had tuberculosis far advanced, blew into the mouth of ten newborn infants, as was her custom, at birth. Every one of those infants died in a short time with tuberculous disease ; while another midwife, who was well, did the same thing to eight other children, doing no harm. Another trustworthy experiment was by Dr. Villemin in Paris, in 1865, who inoculated a number of rabbits and guinea-pigs with tubercles from a human lung, in different parts of the body ; yet the effect was general, as the various examinations revealed after death ; and the same experiments from the matter of a cow revealed the same result.

Professor Chauveau of the Lyons Veterinary School, in 1868, found that rich virulent matter would infect an animal through the digestive organs quite as readily as in any other way. He fed three calves both with the hard and soft varieties of a tubercle from a bovine lung; and in a few weeks marked symptoms of this affection appeared, with loss of appetite, rough, staring coats, occasional fits of coughing, emaciation and diarrhœa. An examination of the different organs revealed characteristic lesions of the transmitted malady; and the fact that animals can contract this disease through the agency of feed should give us new apprehensions in the use of milk from infected cows, which may contain the morbid germs in question. The spread of this disease by contaminated stalls has offered several opportunities for its history and pathology. Dr. Grads' observations at Leinhem paved the way for a series of microscopic investigations, which culminated in this bacillus germ. He chose a thriving young cow, well bred and healthy, and placed her in an infected stall in which five animals had previously died of tuberculosis. No change occurred to her until after calving, when a cough appeared, and gradually increased in frequency, with emaciation and all the attendant symptoms of this malady. The matter had become dried on the boards of the manger, and was the only source by which the germs of the disease could be conveyed to the animal in question.

In the hundreds of experiments by Koch, by inoculation of the cultured bacilli into the abdomen or the eyes of the guinea-pigs, rats, mice, rabbits, cats and dogs which were used, tubercle bacilli were found developing rapidly in a few days or weeks, and in nearly all the organs of the body. The results of these experiments ought to satisfy every candid mind that the old law, "like produces like," is true in bacterial pathology; for all these animals, whether inoculated in the subcutaneous tissues, peritoneal cavity, the aqueous humor of the eye, or directly into the circulation, with cultured bacilli, became tuberculous without a single exception, — not alone in a single place, but scattered throughout all the organs of the body. All these facts led Koch to proclaim, with that air of confidence which diligent labor and research always inspires, that the bacillean germs occurring in tuberculous substance were not merely the attendants of the diseased process, but the cause of them; and that bacilli actually represented the true tuberculous virus. A disease, therefore, that can be transmitted from one animal to another by inoculation, and an identical virus be reproduced, is, strictly speaking, contagious.

Professor Chauveau of the Lyons Veterinary School also proved, by his experiments, that cattle can be as readily affected through the stomach or digestive organs as by any other channel. He purchased four calves, the 18th of September, from a locality where the disease was unknown; they were all in a fine, healthy condition. The next day he administered tuberculous matter, from an old cow's lung, prepared in the form of a drench, to three of them in divided doses. The first one, a year old, began to lose condition in about two weeks; the respirations were quickened, appetite remaining unimpaired. On the 5th of October gave another dose, but of different and more recent matter; and within one week the symptoms of tuberculosis were apparent,—emaciation proceeded rapidly, coat became rough and staring, fits of coughing, etc. The second calf went on comparatively healthy for three weeks, then failed rapidly. The third resisted the disease longer, and another drench was given, the third week after which the tubercular symptoms developed rapidly. At the close of the experiments, beginning September 19 and ending on the 10th of November, the miserable aspect of the three infected calves, when contrasted with the condition of the fourth, left no doubt of the changes that had taken place. The post-mortem examinations revealed a perfect generalized form of tuberculosis, —the morbid deposits in the chest, the lungs studded with tubercles varying in size from a pea to a filbert, the bronchial glands, lesions of the bowels, etc. Thus, in the space of about fifty days, we have these typical examples, nearly uniform in appearance, of the artificial production of this malady through the digestive organs.

Dr. Orth insists, after many experiments, that the meat of tuberculous animals is dangerous as an article of food, and should never be used. Professor Otto Bollinger of the University of Munich, by his investigations of milk of such animals, claims that it has a permanently contagious influence, and reproduces the disease in other animals or in man.

He believes also that such milk, even when boiled, still contains its injurious properties. Fleming says, in his sanitary police, that there is every reason to prohibit the use of milk from cows affected with tuberculosis, and especially with infants, who mainly rely upon this fluid for their sustenance, and whose powers of absorption are active. It has been known for a long time that it was liable to produce diarrhœa and debility in infants; and, though many children have died from tuberculosis of a localized type in the bowels, known as "tabes mesenterica," the part probably played by this liquid in its production has rarely been suspected. Professor Murray says tuberculosis is a constitutional contagious disease, occurring most frequently among pedigreed cattle, — a disease for which there is no cure. Such diseased cattle should never be kept for breeding, and it is dangerous to use the milk for calves or human beings.

Tuberculosis affects cattle also that are not pure-bred. In the herd of cows at the State Primary School at Monson three have died within the last six months, or were killed. Post-mortems of two revealed tuberculosis in the severest or last stages, with pus infiltrated throughout the lungs; of the third no examination was made, but it had all the symptoms, — staring coat, poor in flesh, coughing, etc. She had been turned to pasture with young stock, but grew so poor that she had to be killed. Now the question comes as to the balance of the herd of fifty or more cows, giving milk for the hundreds of children at the school. How came these cows to be affected with this disease? One of them I learn came from a herd near by, and from that herd milk is sold from the cart in the village of Palmer daily, and has been for years. Did it come from a cow that had been slaughtered for beef some two or more years ago? On opening her, the pleura and other organs were studded all over with nodules or warty excrescences, as they were called, in countless numbers. The superintendent wisely ordered it buried.

Ought there not to be a thorough examination, by a competent expert, of this herd; and, if any of the cattle belonging to the State (in this school) have this disease, should they not be killed at once? These tuberculous cows having been kept with others until one not familiar at all with the disease could discover that something was wrong, and until unmistakable symptoms of disease of some kind existed, would lead us to suppose that others had become affected or had contracted the disease from them.

There is no doubt that milk is sold daily in this State from diseased cows. I know, or am informed from good authority, of two herds of cows with hoof ail or foot-rot (or whatever the proper name may be) that have been affected for a year or more; one sending milk to Boston daily, the other making butter and sending to Springfield weekly. The milk from tuberculous cows may be used or sold unwittingly at first, as the disease is so insidious, and may be quite a long time in developing; but it is fatal. These bacilli are hard to kill, and you will find them in the cream, in butter and cheese. In milk, when boiled and reboiled, they are alive still.

A national conference was held at Springfield, Ill., in December last, of State boards of live stock commissioners, for the purpose of discussing what new and uniform legislation, if any, should be recommended for enactment by the various State Legislatures for the extirpation of tuberculosis and "big jaw" (*actinomycosis*) among cattle. Representatives of the Illinois, Indiana, Ohio, Michigan, Wisconsin and Montana State boards were present. At this meeting, a paper was read from the pen of Prof. James Law of Cornell University, who has given this subject a great deal of time and study, and, from his distinguished position, is worthy of consideration. I quote some extracts from this paper, to enforce the importance of this subject. He says: —

> The subject to be considered at Springfield is transcendently important in view of the enormous mortality in our large city populations, especially from tuberculosis. If, as according to different statements, one in four, or one in seven, deaths in certain cities are those of consumption, it follows that in this disease we confront an evil to which the ravages of the much-dreaded cholera, yellow-fever or small-pox are comparatively slight. Tuberculosis is unheeded because it is a "pestilence that stalketh in darkness," because its onset is slow and hidden, and because its too-frequently fatal ending is more or less delayed. . . . If it affected the human race only there might be more ground for hope; but when we trace

its ravages in the animals that live in association with man, — cattle, goats, swine, hens, rabbits, guinea-pigs, rats, mice, cats, and, to a less extent, in sheep, dogs and horses, — and also in many wild beasts and birds, of which man makes articles of diet, one may well stand in awe of the prospect. When we consider that the expectorations and other infecting products of all these different races can be dried up without losing their virulence, and, as fine dust, can be carried on the winds to man and beast, we realize how ubiquitous the germ must be in certain localities, and we wonder how the victim of transient sore throat or bronchitis can run such a gauntlet and escape unscathed. When we consider that man has to run all such risks, and, in addition, in his tender years the danger of tuberculous milk, and in his mature age the peril of tuberculous meat as well, we are compelled to conclude that, terrible as is the harvest now garnered by consumption, it would be incomparably greater but for the strong force of vital resistance opposed to the germ by a vigorous, healthy human system. But, as the transient inflammation throws even the robust system open to the attack of the tubercle bacillus, no one can count himself free from a danger so wide-spread and insidious. As we learn more of the tuberculosis germ and its habits, one by one of the supposed grounds of safety slide from beneath our feet. . . . It has been claimed that the blood and flesh are destructive to the germ ; but we find the bacillus carried in the blood from the distant tubercle and secreted in the milk by the apparently healthy udder ; and, as to the flesh, we find tubercles developing in the substance of the red muscle itself. The flesh or milk of the beast suffering from localized tuberculosis cannot therefore any longer be considered safe, though that of the victim of generalized tuberculosis is necessarily much more dangerous. Again, the disease has been held to be intransmissible from the mother to the unborn offspring ; but, although many experiments have failed to transmit it in this way, the tuberculous cow, aborting at the eighth month of gestation, has produced a fœtus already tuberculous. Again, it has been held that salting the meat kills the germ ; but culture experiments show the bacillus alive months after the meat has been put in a strong pickle.

Can the disease be exterminated, or how can it be curtailed? is a serious question, in which the whole human family are interested. Some of the helps, as indicated by Professor Law : —

1. Consumptive people must be secluded in such a way as to prevent them from infecting their fellows or the lower animals.

Above all, they must be prevented from going to houses or fields where animals are kept, and the scraps from their tables must on no account be fed to animals. Their expectorations and other secretions must be destroyed by fire, or by some potent chemical disinfectant. . . .

2. All consumptive domestic animals should be promptly killed, and cremated or otherwise thoroughly disinfected.

3. There must be a thorough disinfection of all places where the infected man or animal has been; also of the clothing and excretions of such individual.

4. There must be an expert inspection of all meat animals before killing and after (during skinning and dressing), and there must be a disinfection of every condemned carcass, etc.

There are many more restrictions that could be enumerated, but the length of this paper will preclude me from going further. The following resolutions were unanimously adopted at the meeting of the State Boards at Springfield, Ill.: —

Whereas, It is the expressed opinion of leading scientists that actinomycosis is a contagious disease, capable of communication from one animal to another and from animals to mankind, —

Resolved, That it is the sense of this conference that animals affected with this disease should be destroyed, and that the carcasses thereof should not be used for human food.

Resolved, That it is the sense of this convention that tuberculosis in cattle is a dangerously contagious and infectious disease, destructive to human life when the milk or meat of animals so affected are used for human food.

Resolved, That towns, villages and cities should pass an ordinance requiring all persons who exercise the calling of dairymen, and who keep cows for the purpose of selling their milk, or who shall ship milk into such town, village or city, before they are allowed to sell or in any way dispose of such milk, to procure a certificate from a competent veterinarian, to be designated by such corporation, stating that the cows in such dairy, and from which such milk is drawn, are free from said disease; and that such certificate should be renewed semi-annually under such penalties as may be fixed by such corporations.

Resolved, That the legislatures of the different States should pass laws requiring all persons who keep cows and milk the same, and sell such milk to cheese and butter factories, should procure certificates from some competent veterinarian, designated by the live-stock sanitary commission of that State, or other proper official of such State, that their cows are free from tuberculosis; and that such certificate should be required to be renewed semi-annually, under penalties for failure.

Resolved, That, where there is no suitable legislation on the subject in any State, the Legislature of such State should at once pass ample and sufficient laws for the suppression of the same, and place the execution of such laws in the hands of officers empowered with authority to suppress said disease; and that suitable appropriations should be made to carry out the provisions of such laws.

Resolved, That, in States where suitable laws for the suppression of said disease have been heretofore enacted, it is the sense of this body that the properly constituted authorities of such States should proceed at once to inaugurate the work of suppressing and extirpating said disease in such States.

The following communication upon the subject of tuberculosis was received by the Secretary, to be read at the annual meeting of the Board: —

LEGATION OF THE UNITED STATES,
LISBON, Jan. 7, 1890.

DEAR SIR: — In the "Boston Journal" of the 20th of December last I find the following telegram: —

> SPRINGFIELD, ILL., December 19. — Ten States were represented yesterday at the National Conference of Live Stock Commissioners, called for the purpose of conferring upon the subject of uniform recommendation for the suppression of contagious diseases among domestic animals. A very long communication was presented by Prof. James Law of Cornell University, upon the communicability of tuberculosis to man by domestic animals. It was somewhat startling in its tone, but entirely theoretical. It assumed the matter to be positively settled. Dr. John H. Rauch of the State Board of Health said that the theory is by no means sufficiently settled to warrant legislation, although it is attracting very general attention in England, France and Germany.

This discussion, which took place in one of the great cattle-growing sections of the United States, the theoretical views presented by Mr. Law, and the conservative suggestion of Dr. Rauch, have attracted my attention, as they have undoubtedly that of every one interested in the cattle industry of our country, and its connection with the health of the community. The statements made with regard to the existence of tuberculosis, and the danger of its being imparted to the human family by the products of the stall and the dairy, have in a few isolated instances produced such an impression on the minds of some public-spirited farmers that they have destroyed their dairy herds, have on post-mortem examination found them to be diseased, and have offered their information and their example to the agricultural community in which they reside, and to the market in their neighborhood.

I understand that before this destruction took place a careful investigation was made into the history and extent of the disease in the herds, into the causes which produced the disease in those localities, and into the length of time during which the disease had existed. I suppose, moreover, neighboring herds were examined, to ascertain how much disease still remained, and whether or not the danger had been removed. It would be important and most interesting to know the extent of tuberculosis in the great dairy regions of the United States, and its comparative prevalence in different climates and localities, and under the various methods of housing and feeding.

In diagnosing the contagious diseases of animals, we depend largely upon the history of the case before us and the exposure of the animal, so difficult is it to arrive at a conclusion except by history or by an autopsy. In examining non-contagious diseases, we have no historical facts to guide us, and must of necessity grope in the dark, with a dumb and unintelligent case before us, in which we depend on symptoms alone, with no knowledge whatever of the sensations. It would be no easy task for the most skillful veterinary surgeon to decide how much tuberculosis, if any, exists in a herd of apparently healthy animals, or in a badly conditioned herd which has been wintered on hard fare, even when he has discovered the disease by autopsy in the region where the herd is kept. And, when an examination reveals the existence of the disease in localities supposed to be healthy, the question might arise, How many generations of men have been exposed to its influence, unconscious of any ill effects?

In an economical point of view, the possibility of investigating, ascertaining to a certainty, and eradicating, tuberculosis, in a wide agricultural community, counting the cost and the suspension of business, presents a startling problem, as does also the inquiry as to the sources from which a supply of healthy cattle can be surely obtained, to take the places of those that have been destroyed. The questions connected with the human economy also are most important, and should not be overlooked or settled by mere assertion. The predisposing causes of consumption, which is the most common form in which tuberculosis presents itself in the human subject, should not be forgotten. The careful observer knows well how much food, clothing, habits of life, inheritance, location of dwelling, have to do with the development of a scrofulous diathesis ; and the inquiry naturally arises, whether this form of disease prevails where no malign influences are found, and where its existence depends on transmission by meat to the human system, and by milk to the systems of all animals that use it. Man has learned to have great confidence in the effect of heat in preparing his food, and in the power of his stomach to digest it ; and with these two powerful weapons he is well armed against the incursion of invisible bacilli and germs. He can afford, therefore, to devote himself to long and careful investigations, when the startling assertions are based on theory.

The position taken by Dr. Rauch is reasonable and prudent, and should commend itself to all who realize the vast importance of the question involved, and the interests at stake, affecting, as they do, human life and health, as well as industrial prosperity.

While the investigation is going on in our own country, I desire to present to the Massachusetts Board of Agriculture a debate which has recently taken place in Paris at a meeting of the Academy of Medicine, in which some of the most scientific members participated.

A commission had at a previous meeting presented a report on tuberculosis, in discussing which M. Lancereaux said : —

> I agree with the commission of the Congress of Tuberculosis in a large part of the opinions it has given. Meanwhile, I believe it is too much controlled by experiment, and not enough by clinics. I believe, for my part, that contagion plays a secondary part in the pathology of tuberculosis ; that this disease is due to many causes, among which are the density of population and dwellings, and living in confined air, both of which play the principal part. Among predisposing causes which are of equally great importance in the spreading of consumption, alcoholism should be placed in the front rank. These considerations lead me to believe that various elements contribute to the development and extension of tuberculosis, and that contagion is not one of these elements. I should advise, therefore, a modification of the conclusion of the commission.
>
> Tuberculosis is a disease most frequent in great centres ; and, in consequence, it is necessary that the public should know the means by which it can protect itself from this contagion.
>
> Two factors causing the disease and controlling the creation of tuberculosis are : predisposition in the organic structure, and the introduction into that structure of a special parasitic agent. The predisposition, which is due to many causes, arises above all from the excessive use of alcohol and too confined air, as has been said.
>
> The sputa, above all, when they are dry are a great cause of contagion. The same may be true with regard to the milk of an animal whose *udder is diseased*, and also in some cases the meat of an animal having tuberculosis. I believe in all these cases it is important to

observe precautions; but they should be governed by the following considerations: —

Prevent alcoholic excess by all means in our power. Make laws which will secure to the workman in his shop and the pupil in his school-room a supply of air necessary to the requirements of health. Apply proper rules to the construction of dwellings, and modify those already in existence so as to avoid crowding.

M. Villemin remarked: "There is one point on which nearly all of us are agreed, and that is, the danger from the expectoration of consumptives. We agree also on the proper prophylactic measures. For a long time experiment has shown the virulent activity of the sputa of persons affected with pulmonary tuberculosis. Twenty years ago I read in this same society a series of experiments, tending to show the natural causes of the transmission of the malady. The discovery of the bacilli of tuberculosis has only confirmed the opinion I then advanced."

If M. Seè has read my work, he will see that I agree with him in the innocuous character of sputa in a liquid state. He will see that I reject, as he does, the idea that the air breathed is susceptible of contamination. He will find there what I have said upon the immunity of physicians and servants in the rooms and hospitals of tuberculous patients is true. It follows that, if we speak of atmospheric infection, it is from the dust of expectorated matter, and not from the presence of tuberculous virus in the air. It is therefore important to take great precaution to remove frequently the sputa of consumptives.

In removing consumptive patients from place to place in railroad cars, care should be taken that none of the expectoration of these patients should be allowed to dry on the carpet, so that the particles may be thrown into the air by the motion of the cars.

I come now to the transmission of tuberculosis by alimentary causes. This sort of contagion is less frequent than that caused by expectorated matter. Milk may be poisonous, it is true, when it is furnished by a cow affected with *mammary tuberculosis*. It may also happen when a diseased cow, in licking herself, shall have impregnated her teats with her contagious discharge.

Concerning the meat of animals, it appears that the juice of certain tuberculous animals produces tuberculosis; and, as the recommendations of the commission apply only to the meat of tuberculous animals, there is no fear that we shall be deprived of the precious resource of raw and bloody meat, so useful to the sick.

It now remains to discuss with M. Seè the conditions which favor or create predisposition to tuberculosis. On this question opinion is greatly divided. Personally, I am inclined to accept the opinion of M. Seè with regard to pneumonia and bronchitis. But, if the commission has considered inflammations of the bronchial tubes and lungs as favorable to the implanting of tuberculous bacilli in those organs, they have based their opinions on the assertions of Koch alone, and not on facts.

The academy, at the close of the debate, appointed a commission composed of advocates of both sides of the question. I have given this discussion in full, as reported, because it covers the most important points of the theory of tuberculous consumption, — its causes, and, so far as possible, its prevention. The causes definitely agreed upon are: predisposition, unhealthy modes of life, and excesses. The alimentary causes are left still on debatable ground. The theory of contagion by the dried particles of sputa evidently leads the investigator to the conclusion that the disease is conveyed to the milk of the cow by the contact of her mouth with her udder when she is diseased. The transmission of bacilli through the lacteal glands is left in doubt by these scientists; and the transmission of the disease by bacilli in the flesh of the animal is apparently not exactly determined in their minds. It is predisposition — a tendency to scrofula — which evidently accounts to them for a large part of the existing disease, and which is created by bad breeding and low feeding, especially when added to the ill effects of exposure to cold, and low, damp localities. These two causes may operate on the animal system as they do on the human system; and as, in the latter, families are found who have a tendency to tuberculosis, so, in the former, breeds of cattle are well known to be especially subject to the disease, on account of their delicate and unhealthy constitutions.

The question of the contagion of tuberculosis is entitled to, and is receiving, the most careful and wide-spread scientific investigation, pathologically and economically. That it is still open, the refusal to accept the milk and meat theories by the Swiss investigators, the doubts expressed by Dr. Rauch, the fortunate reduction of tuberculous disease in those communities where care in regimen and modes of living are exercised, while the use of beef and milk continues, are sufficient evidence. It is gratifying to know that Massachusetts has entered upon this investigation with a determination to reach a well-founded conclusion on a subject which involves the health of its citizens and the prosperity of one of its most important industries.

George B. Loring.

FARMING IN ENGLAND.

BY DR. GEORGE B. LORING.

The farming of England is so often presented to the student and observer of agriculture, that I have examined its condition during the year 1889, with the view of laying it before the Massachusetts Board of Agriculture, not only for instruction, but for the purpose of comparison with that in which the members of the Board have a personal interest. In doing this, I have availed myself of the best authority to be found in the kingdom.

One of the most important steps in the direction of encouraging and improving the agriculture of England during the last year, has been the enactment of a law providing for a board of agriculture and a secretary, who has been elevated to the rank of a cabinet minister. It is gratifying to know that the example set more than forty years ago by Massachusetts, under the influence of Colonel Wilder and the teaching of Mr. Colman, has been adopted by the nation to which we have long turned for instruction; and that the foundation of a department of agriculture by the federal government has attracted the attention of that people who pride themselves on the perfection of their civil system. The establishment of this department, with its most accomplished and efficient head, seems to have given a great stimulus to the legislative encouragement of agriculture in England. The Board itself is composed of some of the most influential agriculturists and statesmen in the United Kingdom; and the act organizing it has been followed by most useful laws and propositions in parliament, with regard to land-holding and transfers, and by liberal grants for the encouraging of various branches of the industry.

One of the most notable events connected with agriculture during the last year was the fiftieth annual exhibition of the Royal Agricultural Society at Windsor, which was held early in July. It was considered the jubilee year of this renowned association, and the anniversary was opened on the 12th of March by a state banquet at St. James's Palace, given by the Queen, who was the president of the great gathering, and presided over by the Prince of Wales in her behalf. The exhibition at Windsor followed in midsummer, the premium list of which amounted to nearly sixty thousand dollars, — £12,000. This secured a total entry of over 4,000 head of live stock, 861 entries of poultry, and covered a space of more than 15,000 feet for the exhibition of implements of husbandry, Many gold medals were presented by the Queen to the prize animals, in her repeated visits to the exhibition. It is said that 155,000 persons visited the show, and that the receipts were £17,208. It is interesting also to know that, even with this large income, the deficiency on account of expenses amounted to £5,000, — a calamity with which some of us in this country can sympathize. Many years ago I was present at a banquet given by the Royal Agricultural Society at York, at the close of an exhibition, over which Prince Albert presided, and where the American minister spoke, — a great, and, as I thought, an appropriate, gathering, similar to those which I have witnessed in Massachusetts on a few occasions since. Last year, however, this ceremony was somewhat circumscribed, and consisted in a royal command to Mr. Jacob Wilson, the honorary director of the society's shows, to dine with the Queen at Windsor Castle, and to receive at her royal hands the honor of knighthood. And, while I am describing the connection of Her Majesty with this great industrial exhibition, I may add with propriety, that, "as the year came to a close, the Queen maintained her character as a successful agriculturist" [I quote the words of one of her faithful subjects] "by taking the championships of both the Birmingham and Smithfield fat stock shows, besides several of the breed championships, and a large number of other prizes."

This exhibition at Windsor took place when I was in London last summer, on my way to Lisbon; and I witnessed with great pleasure the universal interest felt in its success by all classes of people, and the high value set upon it as an encouragement to agriculture. They are not obliged to defend cattle shows in England.

The season of 1889 in England was better than that in the United States. The spring was indeed late, but May and June were all that the farmers could ask, — mild and bright, with occasional showers. The hay crop was in consequence unusually large, with the securing of which the rains of the last half of July and the first half of August interfered, as they did in New England. The grain and potato and root crops were abundant; and, 100 being taken to represent an average crop, the yield of wheat was 101; barley, 96.2; oats, 99.8; potatoes, 100.5; beans, 92.0; pease, 92.1; and roots, 99.9. The wheat crop was further estimated to be one of 30 bushels to the acre; a yield somewhat surprising to many wheat growers in the United States. The official reports of the Board of Agriculture give the acreage and yield of cereal crops in 1889 as follows: Wheat, 2,449,354 acres; yield per acre, 29.91 bushels; total yield, 73,260,178 bushels. Barley, 2,121,530 acres; yield per acre, 31.81 bushels; total yield, 67,485,869 bushels. Oats, 2,888,704 acres; yield per acre, 39.31 bushels; total yield, 113,554,954 bushels. The prices of wheat in England have not varied much from month to month during the year, being in January 31s. 3d., and in December 30s. 11d. per quarter; while in New York the price in January was 34s. 6d. per quarter, and in December 28s. 6d.

The animal industry of England is always interesting. From her flocks and herds the United States breeders have drawn their most valuable blood for every purpose to which animals are devoted; and the English farmer has received from his sales of horses, cattle, sheep and swine, a larger remuneration than from any other branch of his business. I learn that the sales of pure-bred stock during the past year, both of cattle and horses, have been most satisfactory. Early in the year the sales of shire horses were large, the most important of which was the sale of Mr. Gilbey, at which the Duke of Westminster paid five hundred guineas for Stanton Hero, and the Prince of Wales three hundred guineas for the Pride of Fleet. At the shire horse show nearly £10,000 was received at public auction, and during the show the private sales amounted to another £4,000. For hackneys, Suffolks, Cleveland Bays and Clydesdales, the trade has been good. Cattle also sold well. At 43 sales of Shorthorns, 2,323 head were sold for a total of £76,570 14s. 6d., or an average of £32 19s. 3d. each; being a large advance over the prices of 1885, '86, '87 and '88. In Scotland the sales of pure-bred cattle resulted in an average of £22 15s. per head being obtained for Shorthorns, and of £21 18s. for those of the polled Aberdeen breed. Besides these, a good business has been done in the other leading breeds, the Herefords more especially. The great feature of the year, however, has been the growing popularity of the Irish cattle, the Kerrys and the Dexter–Kerrys, many of which have been brought into England. Herds of these small cattle have been established at Windsor and Sandringham; and so great has been the demand for them that the Royal Dublin Society have determined to establish a herd book of the breed. Sales of sheep have also been very satistory, and prices for all the breeds have been better than for many previous years. In the Windsor show no less than £450 were given for three Lincoln sheep, the first, second and third prize winners in the shearling ram class having been purchased to go to Victoria at that price. The demand both from home and foreign buyers was largely increased over former years; the breeders of some varieties, such as the Hampshire Downs, being encouraged to make a great increase in their flocks, and to establish a flock register.

As far as live stock is concerned, the changes are not great. The number of horses used in agriculture, for breeding, and unbroken animals, in 1889 was 1,421,389, as against 1,420,350 in 1888. Of cattle there were 6,139,155 head, against 6,129,375 in 1888; of sheep and lambs, 25,632,000, against 25,267,149; and of pigs, 2,510,803, against 2,404,344. The number of live stock in the kingdom is largely on the increase.

The devotion of the English farmers to their dairy is quite remarkable. They watch the skies and the pastures on account of this industry, and from it they count their surest and most constant income in favorable districts. In 1889 they seem to have had a good season for the manufacture of cheese. The weather has generally been good for manufacturing and ripening. The trade has improved both for fine and common sorts. In the Cheshire district the make has been in excess of previous years, and the quality has been very good. So in Shropshire and in the other cheese-making districts. Professor Sheldon, with true English accuracy and intelligence, says: —

> The season of 1889, for cheese-making purposes, considering the uncommonly early and genial spring, the grassy summer and the bright and dry autumn, will have to be set down as an unusually favorable one. Cattle have had abundance of food all through, and have milked well. The yield of cheese will be a good one, so far as bulk is concerned; but the yield in profit to the farmer will not be what it ought to be, though probably more nearly so than for several years past. Prices range from 40s. to 65s. per hundred weight of 120 pounds.

In Scotland the make of cheese has declined, being ten per cent less than in 1888; while the average price is 2s. per hundred weight greater. In addition to the cheese manufactory, the supply of milk has become a great industry, more especially in the midland districts, as it has in the United States. The price fixed upon by the dealers is 10d. per imperial gallon for six months in winter, and 7d. to 8d. for the other six months. Even these small prices have interfered with the supply of milk for cheese-making; and the increased raising of stock has also reduced the supply for both the market and cheese. Itinerant dairy schools have been established in some of the counties.

The crop area has changed somewhat during the last year. Taking all the corn crops, it will be found that they are grown on 8,075,100 acres, or some 112,600 acres less than in 1888. Green crops also show a decline, 3,299,000 acres having been so cropped, or 172,200 less than the previous year. There is a large increase of permanent pasture.

Insects injurious to vegetation are the farmers' pest in England, as well as in this country. The year 1889 was not unusually disastrous in this respect, except in the case of orchard pests in the early summer. The Hessian fly did his usual damage to the wheat crop, and the barley crop was injured by a disease known as gout. No special insect injury occurred to root and corn crops. But, to counterbalance this, some new pests were observed, among which the most important insect is probably the *Xyleborus dispar*, a small beetle, which has the instinct of tunneling into stems of young plum trees. These tunnels have one horizontal and several vertical galleries, and are so made that they kill the tree completely, and with extraordinary rapidity. The chief attack of the year was on orchard crops, the winter moth and its allies having been very destructive. But steady advance has been made in knowledge of measures which are practically available for field use in some of the worst insect attacks. Instruction in agricultural entomology is gaining ground in England, as well as in America; and the English farmer is ready to acknowledge, when the produce of acres of different countries is so quickly conveyed (as well as the insect pests it contains) to all parts of the world, that great benefit must result from the establishment of the "Association of Official Entomologists," recently started in the United States. And it is the opinion, among scientific agriculturists in England, that this will enable those who are the centres of information in their own countries to both receive and give the best knowledge on the subject; and also that we are gradually altering the state of the geographical distribution of injurious insects is certain; and, as new pests are observed in any country, it will be a great power for the prevention of damage to have unity of action among entomologists of different countries.

Long-continued and constant warfare on the deliberate adulteration of seeds has resulted in England in the practical abandonment of that pernicious fraud; and the controversy with regard to the value of rye grass as a valuable addition to hay fields and pastures has resulted strongly in its favor.

The sketch I have given of the agricultural efforts of England during one year gives an idea of the care and method observed in the pursuit of this industry, and the important position it holds in State and society. The interests of the landed proprietors and tenant-farmers of England occupy a large portion of the industrial thought and legislative work of the kingdom. The solution of questions in which the yeomanry are concerned is considered a most important problem by the economist and the statesman. In its days of prosperity agriculture is considered the pride of the people, and in its adversity it is a foremost object of national solicitude. This is apparent in the hasty sketch I have been able to give of a year's work in the stall and the field, in council and in the encouragement of the producer. To us in America certain questions occur, which are important here and which perhaps might be important there. Why is it that the pasture lands increase in acreage in the neighborhood of large cities and in thickly peopled districts? I have seen small sections so devoted to market gardening as to indicate the adaptation of the soil and climate to that industry, and to demonstrate the profits of such crops. Why is not this form of agriculture included among the great crops which are counted in the agricultural statistics of the kingdom? The American who believes in small farms is curious to know why the Englishman, who has learned by sad experience how unprofitable large farms are, does not endeavor to adopt this rule. The Englishman is prompt and earnest in all measures required for the safety of his cattle and his crops; extirpates pleuro-pneumonia as he would repel an invasion; shuts out foot and mouth disease as he would arm himself against a burglar; but he does not fully lift from his agricultural population the load which weighs them down; does not adopt a system which would undoubtedly increase vastly his wealth and prosperity.

Let me now briefly call the attention of the Board to the agriculture in which we are immediately interested,— not by way of comparison, but as a gratifying record. Massachusetts is not a large State, nor is it remarkable for the fertility of its soil; but the returns of its agricultural industry indicate great energy and skill on the part of its agricultural population. The cereal crop of 1888 was valued at $1,855,145. The dairy products were so skillfully handled that they were valued at $13,080,536. The hay crop was worth $9,676,893; to which are to be added $2,680,804 on account of fruits and berries, and $5,227,194 on account of garden vegetables. The aggregate amount is $55,664,031. Of the educational efforts made here by the Agricultural College, by institutes and associations, granges, exhibitions, addresses and reports, it is hardly necessary to speak, so well and universally are they known. The farming economy of this State, in which $216,230,550 are invested in lands, buildings, implements, animals, orchards and forests, is interesting to every student of affairs. And all the methods here are so entirely different from the methods of Great Britain, that a statement of the one leads naturally to a statement of the other, with the expectation that something may be learned for the benefit of both.

A word in conclusion, with regard to the industrial capacity of our country, of which I gave a general view to the Board last year. The vast area of our land is sufficient to fill our minds with astonishment. Of timber lands we have in the entire country 85,000,000 acres; of coal lands, 5,529,970 acres; of mineral lands, 800,000 acres; of arable lands in the Western States alone 17,800,000 acres, and in the Southern States 25,585,641 acres; of irrigable lands, 30,000,000 acres; of grazing desert, 502,462,827 acres. It is estimated that the entire grazing area is nearly a thousand million acres. With the management of this great area, and with the home consumption of its products, we are all familiar. But we contemplate with great satisfaction the relation they hold to the commerce and finance of the country. The exportation of articles of food is only about five per cent of the amount produced. In 1883 the exports of food products were $362,000,000 sea-port values, about $242,000,000 farm or local values; and this amount out of about $3,000,000,000 produced. When we add to this, that, out of a total of nearly $6,000,000,000 (according to J. R. Dodge, statistician of the United States department of agriculture) of manufactures produced, we export but one dollar for every fifty taken by our home market, the conclusion is manifest. The United States, as producer and consumer, has not yet been equalled.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

AGRICULTURAL EXHIBITIONS FOR 1890, AND AGRICULTURAL
AND SIMILAR ORGANIZATIONS IN THE STATE,
WITH OFFICERS, ETC.

Financial Returns of the Incorporated

SOCIETIES.	Amount originally raised, etc. (P. S., Chap. 114, Sects. 1 and 2.)	Amount now held so invested as a Capital Stock. (P. S., Chap. 114, Sects. 2 and 10.)	Total Market Value of Personal Property belonging to the Society, Other than Notes, Stocks or Bonds.	Amount of Funds drawing Dividends or Interest.	Amount of Bounty received from the Commonwealth the Past Year.	Income from Funds drawing Dividends or Interest.	Amount received from New Members.	Amount received as Donations.
Amesbury and Salisbury,	$1,027 62	$2,573 65	$400 00	$2,573 65	$396 30	$79 42	$27 00	$29 00
Barnstable County,	-	-	-	700 00	600 00	34 00	154 00	253 95
Bay State,	-	-	-	0	400 00	0	165 00	60 00
Berkshire,	8,000 00	8,000 00	86 43	-	600 00	-	292 00	100 00
Blackstone Valley,	540 66	2,500 00	100 00	0	600 00	0	46 00	15 00
Bristol County,	25,500 00	25,500 00	500 00	-	600 00	-	35 00	200 61
Deerfield Valley,	6,000 00	8,583 55	200 00	1,383 55	600 00	-	141 50	8 75
Eastern Hampden,	[1]680 00	[2]7,000 00	0	0	600 00	0	33 00	117 87
Essex,	0	0	1,000 00	13,303 05	600 00	1,008 38	237 00	58 50
Franklin County,	5,956 18	7,000 00	5 00	1,402 40	600 00	62 79	87 50	6 00
Hampden,	-	-	-	1,078 85	0	41 86	55 00	173 95
Hampshire,	4,000 00	4,000 00	150 00	0	600 00	0	70 00	370 20
Hampshire, Franklin and Hampden,	6,204 61	8,800 00	175 00	0	600 00	0	59 00	0
Highland,	1,925 00	3,000 00	100 00	0	600 00	0	35 00	0
Hillside,	2,100 00	4,772 04	168 94	-	600 00	-	130 00	46 85
Hingham,	31,600 00	22,000 00	2,000 00	0	600 00	0	20 00	156 75
Hoosac Valley,	[3]	13,350 00	450 00	-	600 00	-	410 00	-
Housatonic,	-	11,395 27	679 12	1,395 27	600 00	45 61	217 00	-
Marshfield,	6,806 92	11,806 92	500 00	-	600 00	-	40 00	161 65
Martha's Vineyard,	[2]3,000 00	3,462 00	100 00	1,437 00	600 00	71 89	96 00	-
Massachusetts,	-	-	-	-	0	-	-	-
Massachusetts Horticultural,	-	293,000 00	[2]30,000 00	8,000 00	600 00	420 00	740 00	1,000 00
Middlesex,	-	-	-	-	600 00	-	96 00	723 00
Middlesex North,	-	-	200 00	-	600 00	-	37 00	-
Middlesex South,	3,000 00	18,000 00	50 00	0	600 00	-	38 00	152 70
Nantucket,	1,756 17	-	0	0	600 00	0	32 00	2 00
Oxford,	2,165 27	6,400 00	200 00	-	600 00	-	160 00	52 25
Plymouth County,	-	45,000 00	2,000 00	-	600 00	-	43 00	126 77
Spencer,	4,034 08	7,800 00	800 00	0	600 00	0	181 50	332 00
Union,	2,000 00	9,469 04	1,532 89	600 00	600 00	8 00	89 00	-
Worcester,	-	130,000 00	1,356 88	0	600 00	0	645 00	0
Worcester North,	-	-	350 00	-	600 00	-	38 00	-
Worcester North-west,	1,093 70	10,400 00	400 00	0	600 00	0	70 00	0
Worcester South,	1,467 00	14,600 00	-	-	600 00	-	111 00	-
Worcester County West,	12,600 00	12,600 00	1,000 00	0.	600 00	0	40 00	41 95

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[1] As nearly as can be estimated from obscure records. [2] About. [3] Records of society burned in 1875.

CAPITAL STOCK.—

As Returned for the

Amesbury and Salisbury.— Mortgages and savings bank.
Barnstable County.—
Bay State.—
Berkshire.— Real estate.
Blackstone Valley.— Real estate.
Bristol County.— Real estate and personal property.
Deerfield Valley.— Real estate, personal property and bank funds.
Eastern Hampden.— Real estate, buildings, etc.
Essex —
Franklin County.— Real estate and bank stock.
Hampden.—
Hampshire.—Real estate.
Hampshire, Franklin and Hampden.— Real estate and personal property.
Highland.— Buildings, land, fences and track.
Hillside.— Land, buildings and fixtures.
Hingham.— Land, buildings, furniture, etc.
Hoosac Valley.— Real estate and personal property.

SOCIETIES FOR THE YEAR ENDING DEC. 1, 1889.

Amount received from All Other Sources.	Total Amount of Receipts for the Past Year.	Total Amount of Premiums offered.	Total Amount of Premiums and Gratuities awarded.	Total Amount of Premiums and Gratuities paid.	Current Expenses for the Past Year, not including Premiums and Gratuities paid.	Total Amount of Disbursements for the Past Year.	Amount of Cash on Hand.	Total Actual Assets of the Society.	Total Actual Liabilities of the Society.
$817 85	$1,259 83	$900 00	$428 45	$428 45	$680 55	$1,109 00	$36 80	$3,069 22	0
3,072 78	3,480 73	1,655 25	–	1,292 05	2,140 20	3,432 25	48 48	–	$300 00
30,649 81	31,274 81	12,526 50	8,333 00	8,045 00	23,108 99	31,153 99	120 82	0	0
9,899 72	10,891 72	3,812 70	3,235 45	3,008 20	1,797 09	10,805 29	86 43	15,086 43	9,297 49
1,169 12	1,830 12	700 00	735 10	735 10	1,170 82	1,905 92	365 09	3,465 09	400 00
9,670 05	10,505 05	5,000 00	3,261 61	3,060 39	7,924 67	10,985 06	17 86	25,500 00	18,000 00
924 39	1,664 39	1,000 00	894 85	894 85	785 44	1,664 39	–	8,583 55	50 00
1,114 99	1,865 86	1,865 25	863 65	863 65	936 99	1,800 54	65 32	8,625 00	1,375 00
183 86	2,087 74	3,906 00	1,609 75	1,540 50	883 38	2,493 13	0	19,303 05	372 91
1,801 38	2,557 67	1,284 75	1,090 00	997 25	1,430 01	2,774 26	402 40	7,407 40	172 75
810 59	1,081 40	2,185 20	1,100 95	916 10	666 01	1,582 11	189 66	1,268 51	–
538 44	1,578 64	884 00	602 45	602 45	918 26	1,520 71	57 93	2,707 93	875 00
2,234 24	2,893 24	1,328 00	990 00	867 25	1,789 10	2,731 57	169 18	9,000 00	5,100 00
966 57	1,601 57	715 30	603 45	603 45	997 77	1,601 22	35	3,100 00	195 00
814 46	1,591 31	664 75	664 75	664 75	811 45	1,476 20	115 11	4,772 04	0
5,672 19	5,848 94	2,129 30	616 87	616 87	1,830 03	5,474 86	187 04	22,187 04	2,400 00
2,751 85	3,761 85	2,987 50	2,352 50	2,278 00	3,197 16	4,352 16	602 00	13,992 00	1,800 00
5,178 37	5,995 37	3,652 00	3,218 00	3,218 00	2,731 71	5,949 71	233 85	11,679 12	1,147 13
2,136 34	2,920 24	1,452 65	1,182 14	1,155 69	2,079 04	3,261 18	–	12,306 92	4,500 00
1,030 19	1,126 19	800 00	630 07	627 07	297 77	1,135 13	221 44	3,462 00	0
–	–	–	–	–	–	–	–	–	–
38,929 80	41,689 80	6,000 00	5,785 24	5,656 24	36,213 96	41,870 20	4,909 44	297,909 44	37,000 00
55 00	1,474 00	1,822 00	[4]	658 00	746 94	1,404 94	91 66	15,000 00	22,480 00
–	1,886 87	1,485 00	930 11	874 25	2,375 30	–	775 00	30,200 00	4,000 00
1,644 38	2,435 08	1,038 05	763 10	741 10	1,630 05	2,290 20	165 27	18,215 27	7,300 00
595 26	1,229 26	1,385 50	595 17	595 17	458 78	1,053 95	175 31	3,175 31	0
4,963 23	5,775 48	1,350 00	983 75	964 34	4,705 77	5,670 11	105 37	6,400 00	2,000 00
7,710 27	7,880 04	3,576 50	2,685 98	2,685 98	5,194 06	7,845 35	34 69	45,000 00	6,994 31
3,768 43	4,281 93	1,869 25	1,452 00	1,373 76	1,629 90	4,503 66	59 49	7,800 00	3,000 00
1,669 00	2,366 00	1,728 50	1,167 05	1,126 54	574 09	1,700 63	65 37	9,469 04	170 00
25,540 86	26,785 86	10,435 25	8,589 81	8,589 81	14,200 67	28,790 48	1,356 88	131,356 88	40,000 00
4,231 11	4,869 11	[5]	757 90	664 15	3,088 73	3,752 88	1,926 22	5,776 22	0
2,452 75	3,122 75	2,078 00	1,426 25	1,351 80	1,692 65	3,044 45	78 30	10,478 30	1,800 00
3,392 23	4,113 23	2,600 00	1,976 90	[6]2,026 84	1,920 93	4,089 92	302 84	14,600 00	2,253 00
1,310 09	1,992 04	1,603 60	1,240 15	1,198 20	630 01	1,828 21	227 88	12,827 88	0

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[4] No fair held.

[5] No fixed sum.

[6] Part of this was for fair of 1888.

HOW NOW INVESTED.

Year ending Dec. 1, 1889.

HOUSATONIC. — Real estate, railroad stock and bank deposits.
MARSHFIELD — Buildings and land.
MARTHA'S VINEYARD. — Real estate, notes, deposits, cash on hand, etc.
MASSACHUSETTS HORTICULTURAL. — Real estate, library, furniture and bonds.
MIDDLESEX. —
MIDDLESEX NORTH. — Land and buildings.
MIDDLESEX SOUTH. — Real estate.
NANTUCKET. — Ground and buildings.
OXFORD. — Park, buildings, track and woodland.
PLYMOUTH COUNTY. — Real estate, furniture and fixtures.
SPENCER. — Real and personal property.
UNION. — Real estate, cash on hand and at interest.
WORCESTER. — Real estate.
WORCESTER NORTH. — Interests in real estate.
WORCESTER NORTH-WEST. — Real estate, buildings and personal property.
WORCESTER SOUTH. — Land, track, hall, barns, grand stand, cattle sheds.
WORCESTER COUNTY WEST. — Real estate and personal property.

ANALYSIS OF PREMIUMS AND GRATUITIES

SOCIETIES.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid out under Head of Farms, etc.	Amount offered under Head of Farm Stock.	Amount awarded under Head of Farm Stock.	Amount paid out under Head of Farm Stock.	Amount offered under Head of Field and Experimental Crops.	Amount awarded under Head of Field and Experimental Crops.
Amesbury and Salisbury,	$85 00	$20 00	$20 00	$320 00	$117 00	$117 00	$90 00	$5 00
Barnstable County, . .	160 00	24 00	-	468 25	377 00	377 00	147 00	149 75
Bay State, ...	10 00	-	-	9,437 00	6,334 00	-	-	-
Berkshire, . . .	102 00	65 00	61 00	1,371 50	1,050 00	972 00	243 00	188 00
Blackstone Valley, . .	110 00	104 00	104 00	539 00	431 00	431 00	55 00	39 75
Bristol County, . .	269 00	91 00	91 00	1,700 00	811 50	811 50	275 00	49 00
Deerfield Valley, . .	-	-	-	700 00	617 75	-	-	-
Eastern Hampden, . .	-	-	-	742 00	417 00	417 00	64 00	20 00
Essex, ...	614 00	115 00	15 00	1,873 00	729 00	685 00	295 00	75 00
Franklin County, . .	10 00	-	-	864 75	727 50	688 25	-	-
Hampden, ...	326 00	24 00	22 00	765 00	359 25	266 38	139 00	16 00
Hampshire, . . .	16 00	-	-	507 00	411 00	411 00	38 00	22 00
Hampshire, Franklin and Hampden, . . .	-	-	-	784 00	653 50	615 50	46 00	18 25
Highland, ...	-	-	-	459 00	365 25	365 25	45 00	37 00
Hillside, ...	40 00	40 00	40 00	438 00	394 00	394 00	40 00	37 50
Hingham, ...	220 75	15 00	15 00	906 95	428 60	428 60	93 00	-
Hoosac Valley, . . .	80 00	72 00	72 00	872 00	630 50	630 50	196 00	190 00
Housatonic, . . .	114 00	114 00	114 00	1,585 00	1,338 00	1,338 00	415 00	414 00
Marshfield, . . .	111 00	-	-	304 50	251 95	251 95	102 00	3 25
Martha's Vineyard, . .	24 00	6 00	6 00	347 75	286 25	274 51	162 50	43 00
Massachusetts,[1] . .	-	-	-	-	-	-	-	-
Massachusetts Horticultural, ...	300 00	210 00	[2]150 00	-	-	-	-	-
Middlesex,[3] . . .	-	-	-	-	-	-	-	-
Middlesex North, . .	-	-	-	760 00	470 50	-	-	-
Middlesex South, . .	76 00	17 00	17 00	493 00	243 50	243 50	105 00	15 00
Nantucket, . . .	123 00	23 00	23 00	744 62	230 75	230 75	120 00	10 25
Oxford, ...	46 00	36 00	36 00	820 75	476 00	460 70	42 75	37 75
Plymouth County, . .	267 00	55 00	55 00	1,023 00	801 50	801 50	72 00	45 00
Spencer, ...	74 00	49 00	49 00	857 00	669 50	661 50	30 00	27 00
Union, ...	16 00	7 00	7 00	919 75	576 50	567 00	66 50	45 50
Worcester, . . .	-	129 00	-	5,242 00	3,920 00	3,920 00	156 00	133 65
Worcester North, . .	-	32 00	32 00	368 25	368 25	316 25	-	-
Worcester North-west, .	61 00	23 00	23 00	1,063 50	583 50	562 65	-	-
Worcester South, . .	130 00	52 00	52 00	1,286 00	933 75	933 75	50 00	43 00
Worcester County West,	100 00	35 00	35 00	743 00	542 75	524 00	51 00	6 00

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[1] Holds no annual fair.

[2] For 1888.

[3] Held no fair.

FOR THE YEAR ENDING JAN. 1, 1890.

Amount paid out under Head of Field and Experimental Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid out under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	Amount paid out under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid out under Head of Domestic Manufactures.
$5 00	$175 00	$121 95	$121 95	-	$3 25	-	$95 00	$74 50	$74 50
149 75	217 00	91 50	-	$18 00	18 00	$18 00	103 00	96 30	-
-	2,013 00	1,393 00	1,285 00	440 00	400 00	400 00	256 50	208 00	208 00
157 00	297 00	263 50	263 00	65 00	45 00	45 00	363 50	346 75	345 25
39 75	83 00	75 25	75 25	7 50	6 00	6 00	44 50	33 25	33 25
49 00	300 00	207 00	207 00	50 00	43 00	43 00	350 00	287 50	287 50
-	85 50	71 45	71 45	13 00	13 00	13 00	94 00	86 25	86 25
20 00	85 50	81 50	81 50	20 00	11 00	11 00	63 75	60 90	60 90
100 00	676 50	409 50	494 75	36 00	18 00	18 00	198 50	168 75	166 00
-	215 00	171 00	168 50	20 00	13 00	13 00	68 00	61 50	60 00
16 00	245 50	151 75	128 26	18 00	6 00	3 00	83 00	73 50	51 00
22 00	149 00	87 50	87 50	11 00	11 00	11 00	71 00	58 45	58 45
18 25	221 50	158 75	128 50	44 00	20 00	20 00	15 00	104 75	74 50
37 00	34 00	40 45	40 45	10 50	7 00	7 00	84 05	72 80	72 80
37 50	80 00	77 50	77 50	21 00	19 00	19 00	68 00	44 75	44 75
-	328 30	152 65	152 65	20 00	7 25	7 25	96 25	75 09	75 09
190 00	184 50	148 75	148 75	53 00	34 50	34 50	219 00	192 00	192 00
414 00	262 00	232 50	232 50	51 00	50 00	50 00	446 00	418 50	418 50
3 25	171 50	140 25	111 50	23 00	21 00	21 00	202 00	168 14	168 14
40 75	48 00	80 80	80 80	12 50	13 50	13 50	98 00	110 15	110 15
-	-	-	-	-	-	-	-	-	-
-	6,064 50	5,497 08	[2]5,565 26	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	336 50	285 00	10 00	3 00	-	172 50	130 61	-
15 00	169 10	90 80	88 80	6 00	3 00	3 00	64 28	56 80	46 80
10 25	140 25	107 25	107 25	20 00	9 00	9 00	103 15	27 00	27 00
36 39	9 50	8 00	8 00	15 00	11 00	11 00	31 00	30 00	30 00
45 00	261 50	179 80	179 80	51 00	26 00	26 00	178 00	144 68	144 68
23 50	156 75	136 50	91 25	15 00	12 00	12 00	54 25	51 25	42 00
43 00	49 50	42 50	41 19	22 00	12 75	12 50	121 00	103 55	90 10
133 65	747 00	660 12	660 12	130 00	130 00	130 00	162 75	103 35	103 35
-	158 00	158 00	151 30	10 00	10 00	10 00	75 65	75 65	72 15
-	112 50	88 25	83 75	22 00	12 00	12 00	62 00	48 50	45 65
43 00	143 00	96 00	96 00	32 00	32 00	32 00	115 00	91 95	78 80
6 00	69 60	54 20	52 70	25 00	22 00	18 00	72 00	60 70	50 00

Analysis of Premiums and Gratuities — Membership,

SOCIETIES.	Amount awarded for Agricultural Implements.	Amount paid out for Same.	Amount awarded for All Other Objects strictly Agricultural, not already classified.	Amount paid out for Same.	Amount awarded for Trotting.	Amount paid out for Same.
Amesbury and Salisbury,	$5 00	$5 00	-	-	-	-
Barnstable County,	10 00	-	-	-	$444 00	$444 00
Bay State,	[3]	[3]	0	0	0	0
Berkshire,	57 00	55 00	-	-	775 00	775 00
Blackstone Valley,	-	-	-	-	-	-
Bristol County,	104 00	4 00	-	-	1,375 00	1,375 00
Deerfield Valley,	[5]	[5]	$25 00	$25 00	50 00	50 00
Eastern Hampden,	4 00	-	-	-	245 00	245 00
Essex,	50 00	39 00	28 00	28 00	-	-
Franklin County,	-	-	-	-	530 00	530 00
Hampden,	15 00	7 50	2 00	1 00	255 00	255 00
Hampshire,	7 00	7 00	-	-	175 00	175 00
Hampshire, Franklin and Hampden,	25 00	18 00	-	-	560 00	553 00
Highland,	2 75	2 75	-	-	32 00	32 00
Hillside,	10 00	-	-	-	-	-
Hingham,	[5]	-	-	-	-	-
Hoosac Valley,	15 00	15 00	-	-	1,020 00	1,020 00
Housatonic,	-	-	-	-	595 00	595 00
Marshfield,	-	-	-	-	565 00	565 00
Martha's Vineyard,	-	-	-	-	-	-
Massachusetts,	-	-	-	-	-	-
Massachusetts Horticultural,	-	-	-	-	-	-
Middlesex,	-	-	-	-	-	-
Middlesex North,	3 00	-	-	-	-	112 50
Middlesex South,	-	-	-	-	325 00	325 00
Nantucket,	-	-	-	-	-	-
Oxford,	5 00	5 00	-	-	350 00	350 00
Plymouth County,	6 00	6 00	-	-	1,355 00	1,355 00
Spencer,	13 00	8 00	-	-	485 00	485 00
Union,	-	-	74 00	74 00	260 00	260 00
Worcester,	[5]	[5]	65 00	-	2,765 00	2,765 00
Worcester North,	29 00	20 00	-	-	525 00	525 00
Worcester North-west,	17 25	-	-	-	600 00	600 00
Worcester South,	9 50	9 50	5 00	5 00	720 00	720 00
Worcester County West,	19 50	12 50	-	-	500 00	500 00

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[1] And gratuities. [2] About. [3] Certificates of merit.

INSTITUTES, YEAR ENDING JAN. 1, 1890 — *Concluded.*

Amount awarded for Objects Other than Agricultural, not already classified.	Amount paid out for Same.	Number of Persons who received Premiums.	Number of Persons who received Gratuities.	Number of Towns to which the Premiums and Gratuities were disbursed.	Number of Male Members of Society.	Number of Female Members of Society.	Total Membership of Society.	Number of Institutes held.
$60 50	$60 50	[1]186	-	8	118	5	123	3
81 50	-	171	139	11	[2]450	[2]175	[2]625	3
[3]	[3]	[4]346	-	-	-	-	432	5
410 20	407 45	568	25	-	-	-	1,385	3
60 50	60 50	108	69	15	230	182	412	3
75 00	75 00	181	297	14	[2]700	[2]300	1,000	3
32 50	32 50	310	5	26	1,196	220	1,416	3
22 75	22 75	[1]140	-	21	[2]320	[2]229	[2]549	3
60 00	-	[1]362	-	29	1,480	12	1,492	4
88 00	78 75	333	-	24	[2]2,400	[2]400	[2]2,800	4
50 75	28 00	194	4	19	856	186	1,042	4
92 00	5 50	118	1	14	-	-	[2]200	3
21 00	12 00	224	-	19	[2]800	[2]200	[2]1,000	3
46 20	46 20	192	6	25	337	134	471	3
26 75	26 75	348	-	23	475	15	490	5
30 00	30 00	90	238	19	388	201	589	3
103 50	103 50	271	-	15	819	15	834	3
20 00	20 00	480	-	17	1,667	38	1,705	3
-	-	127	285	27	561	302	863	3
63 40	63 40	62	169	4	142	107	249	3
-	-	-	-	-	-	-	-	-
-	-	[6]146	[6]104	-	748	46	794	12
-	-	-	-	-	-	-	-	-
-	-	[1]419	-	16	[2]700	[2]300	[2]1,000	3
12 00	12 00	132	-	8	392	196	588	3
36 25	36 25	183	182	1	195	234	429	3
30 00	27 25	141	4	14	309	275	584	3
73 00	73 00	320	10	22	1,062	684	1,746	3
13 00	10 00	211	20	14	394	367	761	3
35 25	31 75	220	139	25	490	569	1,059	4
816 51	816 51	393	-	107	1,713	46	1,759	3
92 50	62 50	-	-	-	-	-	-	6
53 75	24 75	162	-	23	560	278	838	3
14 20	14 20	126	48	27	876	830	1,706	4
18 00	-	171	34	27	552	43	595	3

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[4] And gratuities and certificates of merit.

[5] Diplomas.

[6] For 1888.

AGRICULTURAL EXHIBITIONS, 1890.

AMESBURY AND SALISBURY at *Amesbury*, September 30 and October 1.

BAY STATE (no fair this year).

BARNSTABLE COUNTY at *Barnstable*, September 9 and 10.

BERKSHIRE at *Pittsfield*, September 9 and 10.

BLACKSTONE VALLEY at *Uxbridge*, September 23 and 24.

BRISTOL COUNTY at *Taunton*, October 7, 8 and 9.

DEERFIELD VALLEY at *Charlemont*, September 11 and 12.

EASTERN HAMPDEN at *Palmer*, September 16 and 17.

ESSEX at *Beverly*, September 23 and 24.

FRANKLIN COUNTY at *Greenfield*, September 25 and 26.

HAMPDEN at *Westfield*, September 17 and 18.

HAMPSHIRE at *Amherst*, September 18 and 19.

HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, October 1 and 2.

HIGHLAND at *Middlefield*, September 3 and 4.

HILLSIDE at *Cummington*, September 23 and 24.

HINGHAM at *Hingham*, September 23 and 24.

HOOSAC VALLEY at *North Adams*, September 16, 17 and 18.

HOUSATONIC at *Great Barrington*, September 24, 25 and 26.

MASSACHUSETTS (holds no annual fair).

MASSACHUSETTS HORTICULTURAL, at *Boston*, September 16 and 17.

MARSHFIELD at *Marshfield*, September 10, 11 and 12.

MARTHA'S VINEYARD at *West Tisbury*, September 2 and 3.

MIDDLESEX at *Concord*, September 24 and 25.

MIDDLESEX NORTH at *Lowell*, September 23 and 24.

MIDDLESEX SOUTH at *Framingham*, September 9 and 10.

NANTUCKET at *Nantucket*, September 3 and 4.

OXFORD at *Oxford*, September 16 and 17.

PLYMOUTH COUNTY at *Bridgewater*, September 17 and 18.

SPENCER at *Spencer*, October 2 and 3.

UNION at *Blandford*, September 10 and 11.

WORCESTER at *Worcester*, September 18 and 19.

WORCESTER EAST at *Lancaster*, September 10 and 11.

WORCESTER NORTH at *Fitchburg*, September 23 and 24.

WORCESTER NORTH-WEST at *Athol*, September 30 and October 1.

WORCESTER SOUTH at *Sturbridge*, September 11 and 12.

WORCESTER COUNTY WEST at *Barre*, September 25 and 26.

STATE BOARD OF AGRICULTURE.

Members ex officio.

HIS EXCELLENCY J. Q. A. BRACKETT.
HIS HONOR WM. H. HAILE.
HON. HENRY B. PEIRCE, *Secretary of the Commonwealth.*
H. H. GOODELL, M. A., *President Massachusetts Agricultural College.*

Members Appointed by the Governor and Council.

	Term Expires.
GEORGE B. LORING, M.D., of Salem,	1891
JAMES W. STOCKWELL of Sutton,	1892
JAMES S. GRINNELL of Greenfield,	1893

Members Chosen by the Incorporated Societies.

Amesbury and Salisbury,	WM. H. B. CURRIER of Amesbury,	1891
Barnstable County,	NATHAN EDSON of Barnstable,	1892
Bay State,	F. H. APPLETON of Peabody (P. O. Lynnfield),	1893
Berkshire,	ALONZO BRADLEY of Lee,	1891
Blackstone Valley,	VELOROUS TAFT of West Upton,	1891
Bristol County,	N. W. SHAW of North Raynham,	1893
Deerfield Valley,	J. D. AVERY of Buckland,	1893
Eastern Hampden,	WM. HOLBROOK, M. D., of Palmer,	1891
Essex,	BENJAMIN P. WARE of Marblehead (P. O. Clifton),	1893
Franklin County,	J. C. NEWHALL of Conway,	1892
Hampden,	GEO. S. TAYLOR of Chicopee Falls,	1891
Hampshire,	D. A. HORTON of Northampton,	1892
Hampshire, Franklin and Hampden,	F. K. SHELDON of Southampton,	1891
Highland,	HIRAM TAYLOR of Middlefield,	1893
Hillside,	WM. BANCROFT of Chesterfield,	1893
Hingham,	EDMUND HERSEY of Hingham,	1891
Hoosac Valley,	S. A. HICKOX of South Williamstown,	1891
Housatonic,	J. H. ROWLEY of South Egremont (P. O. Great Barrington),	1891
Marshfield,	GEO. J. PETERSON of Marshfield (P. O. Green Harbor),	1891
Martha's Vineyard,	N. S. SHALER of Cambridge,	1892
Massachusetts,	E. F. BOWDITCH of Framingham,	1891
Massachusetts Horticultural,	E. W. WOOD of West Newton,	1891
Middlesex,	W. W. RAWSON of Arlington,	1891
Middlesex North,	A. C. VARNUM of Lowell,	1892
Middlesex South,	S. B. BIRD of Framingham,	1893
Nantucket,	CHAS. W. GARDNER of Nantucket,	1891
Oxford,	D. M. HOWE of Charlton (P. O. Oxford),	1892
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1893
Spencer,	J. G. AVERY of Spencer,	1892
Union,	C. B. HAYDEN of Blandford,	1892
Worcester,	C. L. HARTSHORN of Worcester,	1893
Worcester North,	GEORGE CRUICKSHANKS of Fitchburg,	1893
Worcester North-west,	WM. H. BOWKER of Boston,	1892
Worcester South,	G. L. CLEMENCE of Southbridge,	1892
Worcester County West,	P. M. HARWOOD of Barre,	1893

Secretary of the Board, WM. R. SESSIONS of Hampden.
Chemist to the Board, C. A. GOESSMANN, Ph.D., LL.D., of Amherst.
Entomologist to the Board, C. H. FERNALD, Ph.D., of Amherst.
Office of the Secretary, Commonwealth Building, Boston.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

BOARD OF TRUSTEES.

	Term Expires.
JAMES S. GRINNELL of Greenfield,	1891.
JOSEPH A. HARWOOD of Littleton,	1891.
WILLIAM H. BOWKER of Boston,	1892.
J. D. W. FRENCH of North Andover,	1892.
THOMAS P. ROOT of Barre,	1893.
J. HOWE DEMOND of Northampton,	1893.
FRANCIS H. APPLETON of Peabody,	1894.
WILLIAM WHEELER of Concord,	1894.
ELIJAH W. WOOD of West Newton,	1895.
CHAS. A. GLEASON of New Braintree,	1895.
DANIEL NEEDHAM of Groton,	1896.
JAMES DRAPER of Worcester,	1896.
HENRY S. HYDE of Springfield,	1897.
MERRITT I. WHEELER of Great Barrington,	1897.

MEMBERS EX OFFICIO.

His Excellency Governor J. Q. A. BRACKETT,
President of the Corporation.

HENRY H. GOODELL, M. A.,	*President of the College.*
JOHN W. DICKINSON,	*Secretary of the Board of Education.*
WILLIAM R. SESSIONS,	*Secretary of the Board of Agriculture.*

OFFICERS ELECTED BY THE BOARD OF TRUSTEES.

JAMES S. GRINNELL of Greenfield,	*Vice-President of the Corporation.*
WILLIAM R. SESSIONS of Hampden,	*Secretary.*
FRANK E. PAIGE of Amherst,	*Treasurer.*
CHARLES A. GLEASON of New Braintree,	*Auditor.*

BOARD OF OVERSEERS.

The State Board of Agriculture.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

HENRY H. GOODELL, M. A.,	*Director.*
WILLIAM P. BROOKS, B. Sc.,	*Agriculturist.*
SAMUEL T. MAYNARD, B. Sc.,	*Horticulturist.*
CHARLES H. FERNALD, Ph. D.,	*Entomologist.*
CLARENCE D. WARNER, B. Sc.,	*Meteorologist.*

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Location, Amherst, Hampshire County.

BOARD OF CONTROL.

His Excellency J. Q. A. BRACKETT, Governor of the Commonwealth, *President ex officio.*

	Term Expires.
WARREN W. RAWSON of Arlington,	1891.
PETER M. HARWOOD of Barre,	1892.
Elected by the State Board of Agriculture.	
THOMAS P. ROOT of Barre,	1891.
J. HOWE DEMOND of Northampton,	1893.
Elected by the Board of Trustees of the Massachusetts Agricultural College.	
FRANCIS H. APPLETON of Peabody,	1891.
Elected by the Massachusetts Society for Promoting Agriculture.	
ELBRIDGE CUSHMAN of Lakeville,	1892.
Elected by the Massachusetts State Grange.	
WILLIAM C. STRONG of Newton Highlands,	1891.
Elected by the Massachusetts Horticultural Society.	

HENRY H. GOODELL, M. A., of Amherst, *President of the Massachusetts Agricultural College.*

CHARLES A. GOESSMANN, Ph. D., LL. D., of Amherst, *Director of the Station.*

WILLIAM R. SESSIONS of Hampden, *Secretary of the State Board of Agriculture.*

OFFICERS ELECTED BY THE BOARD OF CONTROL.

WILLIAM R. SESSIONS of Hampden,	*Secretary and Auditor.*
FRANK E. PAIGE of Amherst,	*Treasurer.*
CHARLES A. GOESSMANN, Ph. D., LL. D., of Amherst,	*Director and Chemist.*
JAMES E. HUMPHREY, S. B., of Amherst,	*Vegetable Physiologist.*

BOARD OF CATTLE COMMISSIONERS.

	Term Expires.
LEVI STOCKBRIDGE of Amherst, *Chairman,*	1891.
ALONZO W. CHEEVER of Dedham, *Secretary,*	1890.
OBADIAH B. HADWEN of Worcester,	1892.

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,*	F. W. Sargent, Amesbury.	A. H. Fielden, Amesbury.	W. H. Dewhurst, Amesbury.
Barnstable County, .	John Simpkins, Yarmouth.	F. C. Swift, Yarmouthport.	A. F. Edson, Barnstable.
Bay State, . . .	H. S. Russell, Milton.	F. H. Appleton, Lynnfield.	Wm. H. Bowker, Boston.
Berkshire, . . .	Alonzo Bradley, Lee.	F. F. Read, Jr., Pittsfield.	J. P. Merrill, Pittsfield.
Blackstone Valley, .	C. C. Capron, Uxbridge.	A. R. Taft, Uxbridge.	F. W. Barnes, Uxbridge.
Bristol County, . .	S. P. Richmond, Freetown.	D. L. Mitchell, Taunton.	W. F. Kennedy, Taunton.
Deerfield Valley, . . .	C. B. Newell, Rowe.	M. M. Mantor, Charlemont.	J. A. Wells, Charlemont.
Eastern Hampden, . .	H. P. Holden, Palmer.	O. P. Allen, Palmer.	O. P. Allen, Palmer.
Essex, ...	B. P. Ware, Clifton.	D. W. Low, Gloucester.	G. L. Streeter, Salem.
Franklin County, . .	C. W. Leighton, Greenfield.	F. L. Greene, Greenfield.	F. L Greene, Greenfield.
Hampden, . . .	C. F. Fowler, Westfield.	Ethan Brooks, West Springfield	E. S. Batchelder, Springfield.
Hampshire, . . .	L. W. West, Hadley.	H. C. Nash, Jr., Amherst.	H. C. Nash, Jr., Amherst.
Hampshire, Franklin and Hampden, . . .	E. C. Clapp, Northampton.	—	D. J. Wright, Northampton.
Highland, . . .	Edward Pease, Huntington.	J. McElwain, Middlefield.	M. J. Smith, Middlefield.
Hillside, ...	Alvan Barrus, Goshen.	Wm. G. Atkins, West Cummington.	R. R. Packard, Cummington.
Hingham,* . . .	E. L. Ripley, Hingham.	Wm. H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley, . .	J. M. Waterman, Williamstown.	G. F. Miller, North Adams.	S. B. Dibble, North Adams.
Housatonic, . . .	F. A. Palmer, Stockbridge.	H. T. Robbins, Great Barrington.	F. H. Wright, Great Barrington.
Marshfield,* . . .	G. W. Emery, Marshfield.	Francis Collamore, Pembroke.	Francis Collamore, Pembroke.
Martha's Vineyard, .	Wm. J. Rotch, West Tisbury.	B. T. Hillman, Chilmark.	Wm. B. Mayhew, West Tisbury.
Massachusetts, . .	Thomas Motley, Jamaica Plain.	E. F. Bowditch, Framingham.	J. C. Rogers, Boston.
Middlesex, . . .	W. W. Rawson, Arlington.	Wm. H. Hunt, Concord.	D. G. Lang, Concord.
Middlesex North, . .	A. C. Varnum, Lowell.	E. T. Rowell, Lowell.	S. Drewett, Lowell.
Middlesex South, . .	N. B. Douglas, Sherborn.	S. B. Bird, Framingham.	C. J. Frost, Framingham.

Nantucket,	G. H. Gardner, Nantucket.	Albert Easton, Nantucket.	Asa C. Jones, Nantucket.
Oxford,	J. P. Dana, Oxford.	W. H. H. Thurston, Oxford.	W. H. H. Thurston, Oxford.
Plymouth County,	J. C. Swan, M.D., West Bridgewater.	G. W. R. Hill, Brockton.	Geo. M. Hooper, Bridgewater.
Spencer,	C. N. Prouty, Spencer.	T. J. Comins, Spencer.	I. L. Prouty, Spencer.
Union,	C. M. Blair, Blandford.	E. W. Boise, Blandford.	W. J. Peebles, Blandford.
Worcester,	J. L. Ellsworth, Worcester.	F. H. Chamberlain, Worcester.	F. H. Chamberlain, Worcester.
Worcester East,	J. E. Thayer, Lancaster.	W. A. Kilbourn, S. Lancaster.	Lucius Field, Lancaster.
Worcester North,	Geo. Cruickshanks, Fitchburg.	S. W. Huntley, Fitchburg.	A. F. Whitney, Fitchburg.
Worcester North-west,	J. D. Morton, Boston.	J. F. Whitcomb, Athol.	T. H. Goodspeed, Athol.
Worcester South,	E. B. Lynde, West Brookfield.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	Wm. A. Warner, Hardwick.	Matthew Walker, Barre.	J. C. Bartholomew, Barre.

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* And horticultural.

AGRICULTURAL SOCIETIES INCORPORATED UNDER GENERAL LAW.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Brockton,	Brockton,	H. W. Robinson, Brockton.	Ira Copeland, Brockton.
Westborough,	Westborough,	N. P. Brown, Westborough.	S. W. Rice, Westborough.
Weymouth,*	South Weymouth,	B. F. Poole, Weymouth.	J. G. Hutchins, South Weymouth.

* And industrial.

HORTICULTURAL SOCIETIES.

Hampden County,	Springfield,	J. E. Taylor, Springfield.	B. L. Bragg, Springfield.
Houghton,	Lynn,	J. W. Goodell, M. D., Lynn.	Frank W. Mace, Lynn.
Hyde Park,	Hyde Park,	W. C. Eustis, Hyde Park.	R. M. Johnson, Hyde Park.
Massachusetts,*	Boston,	Wm. H. Spooner, Jamaica Plain.	Robert Manning, Boston.
Newton,	Newton,	D. D. Slade, Newton.	L. H. Farlow, Newton.
Springfield Amateur,	Springfield,	C. L. Simons, Springfield,	G. H. Lapham, Springfield.
Wakefield,†	Wakefield,	W. F. Young, Wakefield.	Mrs. J. F. Woodward, Wakefield.
Worcester County,	Worcester,	H. L. Parker, Worcester.	E. W. Lincoln, Worcester.

* Incorporated and represented on the Board of Agriculture. † And agricultural.

FARMERS' AND MECHANICS' ASSOCIATIONS.

Princeton,	Princeton,	C. H. Houghton, Princeton.	J. E. Merriam, Princeton.
Oakham,	Oakham,	H. P. Austin, Oakham.	W. M. Robinson, Oakham.
Needham,	Needham,	James Macintosh, Needham.	R. E. Ames, Needham.
Leominster,	Leominster,	C. S. Buss, Leominster.	C. H. Rice, Leominster.

Shirley,	Shirley,	M. W. Longley, Shirley.	G. C. Boutwell, Shirley.
Bolton,	Bolton,	H. F. Haynes, Bolton.	W. M. Brigham, Bolton.
Middlesex and Worcester,	Hudson,	R. H. Hapgood, Hudson.	J. S. Welch, Hudson.

FARMERS' AND MECHANICS' CLUBS.

West Acton,	West Acton,	Isaac Reed, West Acton.	C. B. Stone, West Acton.
Ashby,	Ashby,	W. H. C. Lawrence, Ashby.	E. A. Hubbard, Ashby.
Berlin,	Berlin,	P. B. Southwick, Berlin.	F. H. Crossman, Berlin.
Groton,	Groton,	Daniel Needham, Groton.	Charles Woolley, Groton.
Wilmington,	Wilmington,	H. A. Sheldon, Wilmington.	E. M. Nichols, Wilmington.
Belchertown,	Belchertown.	D. F. Shumway, Belchertown.	G. H. B. Green, Belchertown.
Shrewsbury,	Shrewsbury,	G. H. Harlow, Shrewsbury.	S. D. Ward, Shrewsbury.

FARMERS' CLUBS.

Lunenburg,	Lunenburg,	J. H. Witherell, Lunenburg.	James Hildreth, 2d, Lunenburg.
Southborough,	Southborough,	C. C. Choate, Southborough.	D. W. C. McMasters, Southborough.
Tatnuck,	Worcester,	W. W. Clapp, Worcester.	F. J. Kinney, Worcester.
Chamberlain District,	Worcester,	Pliny Moore, Worcester.	S. A. Burgess, Worcester.
Lancaster,	Lancaster,	Nicholas Frost, Lancaster.	F. A. Hanaford, Lancaster.
Wilbraham,	Wilbraham,	H. H. Burbank, Wilbraham.	H. M. Bliss, Wilbraham.
Sutton,	Sutton,	O. P. Johnson, Sutton.	A. W. Putnam, Sutton.
Dartmouth,	North Dartmouth,	L. T. Davis, Dartmouth.	A. J. Potter, North Dartmouth.
Royalston,	Royalston,	A. D. Raymond, Royalston.	G. E. Pierce, Royalston.
Ashfield,	Ashfield,	C. S. Goodwin, Ashfield.	A. G. Howes, Ashfield.
Halifax,	Halifax,	V. B. Grover, Halifax.	Mrs. J. S. Pope, Halifax.
East Charlemont,	East Charlemont,	O. Maxwell, East Charlemont.	F. H. Giles, East Charlemont.
North Raynham,	North Raynham,	E. B. Hall, North Raynham.	N. W. Shaw, North Raynham.

AGRICULTURAL SOCIETIES — *Concluded.*

Farmers' Clubs — *Concluded.*

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Rutland,	Rutland,	Daniel Demond, Rutland.	S. W. Fay, Rutland.
New Salem,	New Salem,	D. F. Carpenter, Millington.	Daniel Ballard, New Salem.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Geo. A. Potter, New Bedford.
Holden,	Holden,	E. J. Miles, Holden.	E. Truesdell, Holden.
West Brookfield,	West Brookfield,	W. E. Pabrick, Warren.	L. H. Chamberlain, West Brookfield.
Rehoboth,	Rehoboth,	H. T. Horton, Rehoboth.	Ellery L. Goff, Rehoboth.
Buckland,	Buckland,	E. D. Bement, Buckland.	Mrs. M. H. Forbes, Buckland.
Marblehead and Swampscott,	Beach Bluff,	Wm. Miller, Swampscott.	Bella Miller, Swampscott.
Easthampton,	Easthampton,	Theron Pomeroy, Easthampton.	C. W. Smith, Easthampton.
Upton,	Upton,	B. A. Jourdan, Upton.	J. S. Le Sure, Upton.
West Peabody,	West Peabody,	G. H. Legro, West Peabody.	Mrs. E. A. Needham, West Peabody.
Boxborough,	Boxborough,	C. T. Wetherbee, Lincoln Depot.	A. W. Wetherbee, West Acton.
Practical,	Egremont,	J. A. Kline, North Egremont.	Mrs. H. Z. Cande, Sheffield.
Franklin,	Franklin,	L. W. Daniels, Franklin.	C. M. Allen, Franklin.
New Braintree,	New Braintree,	J. E. Barr, New Braintree.	Horatio Moore, New Braintree.
Huntington,	Norwich,	C. H. Strong, Norwich.	H. W. Stickney, Norwich.
West Bridgewater,	West Bridgewater,	F. E. Howard, West Bridgewater.	Mrs. H. J. Le Lacheur, W. B'dgew't'r.
Sterling,	Sterling,	J. S. Burpee, Sterling.	Ezra Sawyer, Sterling.
South Deerfield,	South Deerfield,	E. W. Jackson, South Deerfield.	W. W. Sanderson, South Deerfield.
North Westport,	North Westport,	E. L. Gifford, North Westport.	A. S. Sherman, North Westport.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
West Newbury,	West Newbury,	Samuel Rogers, West Newbury.	I. N. Lane, West Newbury.
Waltham,	Waltham,	M. R. Leonard, Waltham.	A. Starbuck, Waltham.
South Byfield,	South Byfield,	C. W. Nelson, Georgetown.	I. N. Dummer, Rowley.
Burlington,	Burlington,	T. J. Reed, Burlington.	A. S. Wood, Burlington.

MISCELLANEOUS.

The Hampden Harvest Club,	Connecticut Valley,	The Members Alternately.	J. N. Bagg, West Springfield.
Franklin Harvest Club,	Connecticut Valley,	S. B Slate, Greenfield.	C. B. Lyman, Southampton.
Young Men's Harvest Club,	Ludlow,	E. N. Fisher, Ludlow.	C. B. Bennett, Ludlow.
Agricultural Library Association,	Swansea,	N. B. Gardner, Swansea.	A. E. Arnold, Swansea.
Farmers' and Gardeners' Association,	Hanson,	A. Damon, Hanson.	F. S. Thomas, M. D., Hanson.
Boston Market Gardeners' Assoc'n,	Boston and vicinity,	W. W. Rawson, Arlington.	G. H. Cutter, Arlington.
Cranberry Growers' Association,	Cape Cod District,	J. J. Russell, Plymouth.	I. T. Jones, Sandwich.
Bristol Co. Fruit Growers' Assoc'n,	Dighton,	Wm. P. Hood, Somerset.	W. P. Eddy. Dighton.
Attleboro' Agricultural Association,	Attleborough,	W. M Fisher, Attleborough.	L. F. Mendell, Plainville.

POULTRY ASSOCIATIONS.

Bay State,	Worcester,	C. A. Ballou, Worcester.	H. A. Jones, Worcester.
Brockton Poultry and Pet Stock,	Brockton,	L. A. Tower, West Bridgewater.	Charles A. Snow, Brockton.
Eastern Middlesex,	Woburn,	W. S. Keene, Stoneham.	F. W. Legg, Woburn.
Massachusetts,	Boston,	W. B. Atherton, Boston.	W. F. Bacon, Cambridgeport.
Old Colony,	Quincy,	Preston Pratt, South Weymouth.	J. E. Gardner, South Weymouth.
The Gt. Barrington Poultry, Pigeon and Pet Stock,	Great Barrington,	Samuel Camp, M. D., Great Barrington.	F. D. Rowe, Great Barrington.
Waltham Fanciers' Club,	Waltham,	William E. Bright, Waltham.	F. H. Gordon, Waltham.
Western Massachusetts,	Westfield,	William Provin, Westfield.	J. L. Hanchett, Westfield.

MASSACHUSETTS PATRONS OF HUSBANDRY.

OFFICERS OF THE STATE GRANGE, 1890.

Master,	N. B. Douglas of Sherborn.
Overseer,	P. M. Harwood of Barre.
Lecturer,	George C. Howard of Cochesett.
Steward,	E. A. Emerson of Haverhill.
Assistant Steward,	G. N. Brown of Dalton.
Chaplain,	Rev. C. S. Walker of Amherst.
Treasurer,	F. A. Harrington of Worcester.
Secretary,	George R. Chase of Medfield.
Gate Keeper,	Lyman M. Rice of Grafton.
Ceres,	Mrs. Carrie B. Sage of West Springfield.
Pomona,	Mrs. Harriet M. Judd of South Hadley.
Flora,	Mrs. Minnie M. Chase of Medfield.
Lady Assistant Steward,	Mrs. F. L. Chamberlain of Holden.

EXECUTIVE COMMITTEE.

H. A. Barton, Jr., of Dalton,	One year.
C. A. Dennen of Pepperell,	Two years.
S. E. Stowe of Grafton,	Three years.

DEPUTIES.

S. B. Cook,	Petersham.
A. A. Metcalf,	Holden.
P. M. Harwood,	Barre.
George R. Chase,	Medfield.
A. C. Stoddard,	North Brookfield.
D. A. Horton,	Northampton.
S. V. Crane,	Blackstone.
C. A. Wood,	Hudson.
John H. Smith,	Dalton.
Mrs. F. A. Harrington,	Worcester.
George C. Howard,	Cochesett.
I. C. Day,	South Groveland.
George A. Hastings,	West Berlin.
Warren C. Jewett,	Worcester.
Mrs. Alice M. Davis,	Shrewsbury.
N. T. Smith,	West Springfield.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
District Granges.			
Berkshire County,	F. K. Hinkley, Lee.	Mrs. F. A. Watkins, Hinsdale.	Mrs. A. H. Torrey, Williamstown.
Worcester West District,	Lyman Randall, North Dana.	Lucien Gove, East Templeton.	Mrs. Mattie R. Knapp, Petersham.
Worcester Central County,	J. A. Allen, Auburn.	A. F. Greene, Upton.	Miss Sarah M. Mills, Sutton.
Borough District,	Samuel Wheeler, Berlin.	Mrs. G. B. Wood, Northborough.	Mrs. A. Keyes, Berlin.
Middlesex and Norfolk Union,	Eben Higgins, Dover.	Mrs. K. E. White, Dedham.	Mrs. G. L. Whitney, S. Framingham.
Connecticut Valley District,	C. A. Judd, So. Hadley Falls.	D. A. Horton, Northampton.	J. S. Wells, Hatfield.
Middlesex and Worcester Union,	Daniel Needham, Groton.	James Hildreth, 2d, Lunenburg.	E. A. Emerson, Haverhill.
Worcester South-west District,	A. C. Stoddard, No. Brookfield.	H. H. Kingsbury, Spencer.	Mattie E. Bush, New Braintree.
Franklin and Worcester Union,	A. N. Harrington, No. Orange.	O. F. Hutchins, Orange.	Miss M. B. Hager, Phillipston.
Lancaster District,	W. A. Kilbourn, So. Lancaster.	Mrs. E. A. Currier, Clinton.	Mrs. Fannie Brown, West Boylston.
Springfield District,	F. E. Clark, Wilbraham.	Dr. Geo. T. Ballard, Hampden.	Mrs. W. L. Phelps, Wilbraham.
Old Colony District,	S. H. Nye, East Sandwich.	Amos H. Eaton, Middleborough.	Miss A. C. Tinkham, Middleborough.
Subordinate Granges.			
Groton, No. 7,	Daniel Needham, Groton.	F. M. Boutwell, Groton.	Mrs. E. P. Woolley, Groton.
Barre, No. 9,	J. L. Smith, Barre.	John Hancock, Jr., Barre.	Mrs. H. N. Patterson, Barre.
Amherst, No. 16,	C. S. Smith, Amherst.	Mrs. C. E. Wilson, Amherst.	C. E. Wakefield, Amherst.
Hinsdale, No. 19,	Peter Parsons, Hinsdale.	C. E. Robinson, Hinsdale.	Miss Lettie Raymond, Hinsdale.
Lanesborough, No. 21,	W. F. Farnham, Lanesborough.	P. P. Gardner, Lanesborough.	Chas. H. Deming, Lanesborough.
Worcester, No. 22,	W. C. Jewett, Worcester.	J. E. Goodell, West Boylston.	Miss Ellen M. Flagg, Worcester.
Dalton, No. 23,	W. B. Barton, Dalton.	Mrs. Grace Parker, Dalton.	Miss Jennie E. Hager, Dalton.
"Resolute" of Hatfield, No. 25,	Thaddeus Graves, Hatfield.	S. L. Cutler, Hatfield.	A. H. Graves, Hatfield.
Richmond, No. 32,	O. F. Smith, Richmond.	F. A. Clement, Richmond.	Elizabeth P. Nichols, Richmond.
Sterling, No. 53,	C. E. Boyles, Sterling.	Mrs. L. M. Nelson, Sterling.	H. S. Sawyer, Sterling.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Subordinate Granges. — Con.			
Auburn, No. 60,	William F. Stone, Auburn.	Mrs. J. J. Allen, West Millbury.	S. H. Jewell, Auburn.
"Union" of Belchertown, No. 64,	W. H. Bridgman, Belchertown.	H. C. West, Belchertown.	Thomas Bridgman, Belchertown.
Hardwick, No. 67,	W. A. Clark, Hardwick.	Nellie M. Wesson, Hardwick.	Susie B. Manly, Hardwick.
Shelburne, No 68,	C. M. Long, Shelburne.	Mrs. Julia M. Deane, Shelburne.	A. F. Skinner, Shelburne.
Phillipston, No. 70,	A. D. Clifford, Phillipston.	Cora Smith, Phillipston.	Mrs. Emma Clifford, Phillipston.
"Prescott" of Pepperell, No. 73,	G. E. Shattuck, Pepperell.	Mrs. C. F. Jewett, Pepperell.	Emma J. Dennen, Pepperell.
Holden, No. 78,	C. T. Mead, Holden.	A. A. Metcalf, Holden.	Mrs. S. N. Hubbard, Holden.
Spencer, No. 79,	H. H. Kingsbury, Spencer.	P. Emerson, Spencer.	Miss Emma A. Craig, Spencer.
"Manhan" of Southampton, No. 82,	J. S. Frary, Southampton.	L. C. Tiffany, Southampton.	Mrs. C. P. Gridley, Southampton.
North Orange, No. 86,	M. R. Hartshorn, North Orange.	M. D. Herrick, North Orange.	Flora J. Butterworth, North Orange.
Lee, No. 88,	E. G. Langdon, Lee.	Mrs. E. G. Langdon, Lee.	E. F. Ingersoll, Lee.
Charlton, No. 92,	L. C. Prindle, Southbridge.	A. M. Dodge, Charlton.	Ida L. Burlingame, Charlton.
Grafton, No. 93,	Perley Goddard, Grafton.	Mrs. E. M. W. Fiske, Grafton.	Miss Emma J. Knight, No. Grafton.
Petersham, No. 95,	Elisha Webb, Nichewaug.	Mrs. Martha A. Webb, Nichewaug.	Mrs. Lydia A. Cook, Petersham.
Savoy, No. 99,	W. W. Burnett, Savoy.	L. L. Burnett, Savoy.	Mrs. Nellie I. Burnett, Savoy.
Shrewsbury, No. 101,	W. E. Rice, Shrewsbury.	Mrs. W. W. Maynard, Shrewsbury.	Mrs. Geo. H. Perry, Shrewsbury.
Stow, No. 103,	F. H. Stevens, Stow.	A. J. Smith, Stow.	Mrs. V. M. Lewis, Stow.
"Garfield" of North Dana, No. 104,	C. W. Doubleday, North Dana.	E. A. Albee, North Dana.	Mrs. Ella E. Hanson, Millington.
Marlborough, No. 105,	David Goodale, Marlborough.	J. H. Dyer, Marlborough.	Abbie A. Brigham, Marlborough.
West Boylston, No. 106,	J. F. Knight, West Boylston.	Mrs. A. D. Lord, West Boylston.	Fannie Brown, West Boylston.
Millbury, No. 107,	D. M. Rogers, Millbury.	L. B. Adams, Millbury.	Mrs. Ellen S. Tabor, Millbury.
Hudson, No. 108,	L. W. Bruce, Hudson.	Miss Mary E. Hall, Hudson.	Mrs. F. Emma Wood, Hudson.
Sutton, No. 109,	J. W. Stockwell, Sutton.	Mrs. H. W. Putnam, West Sutton.	Sarah M. Mills, Sutton.
Sherborn, No. 110,	Jonathan Eames, Sherborn.	G. L. Whitney, South Framingham.	Mrs. F. Leland, Sherborn.

Boylston, No. 111, . .	G. A. Hastings, West Berlin.	Mrs. A. V. R. Prouty, Boylston Cen.	Miss Mary A. Doyle, Boylston Centre.
"East Medway" of Millis, No. 112, ...	E. F. Richardson, Millis.	Louis La Croix, Millis.	Geneive F. Howe, Millis.
Framingham, No. 113, . .	Edwin Moultrop, Framingham.	Horatio Twombly, Framingham.	Miss M. Ella Hunt, Fayville.
Medfield, No. 114, . .	William F. Weiker, Medfield.	H. G. Crosby, Medfield.	Mrs. E. C. Woodward, Medfield.
Holliston, No. 115, . .	J. B. Parkin, Holliston.	Miss M. E. Cutler, Holliston.	Mrs. E. P. Eames, Metcalf.
Westborough, No. 116, .	H. A. Gilmore, Westborough.	G. M. Fisher, Westborough.	Mrs. F. J. Gilmore, Westborough.
Dover, No. 117, . . .	A. F. Smith, Dover.	S. Eudora Shumway, Dover.	Eben Higgins, Dover.
Southborough, No. 118, .	C. W. Jennison, Southborough	E. F. Collins, Southborough.	Lucy S. Newton, Southborough.
Northborough, No. 119, .	W. O. Allen, Northborough.	Mrs. C. J. Mack, Northborough.	Mrs. G. B. Wood, Northborough.
Lancaster, No. 120, . .	C. W. Spencer, Lancaster.	W. A. Kilbourn, South Lancaster.	Miss E. C. Divoll, Lancaster.
Sudbury, No. 121, . . .	C. F. Gerry, Sudbury.	Mrs. S. J. White, Sudbury.	Emily F. Willis, Sudbury.
Templeton, No. 122, . .	H. S. Coy, Templeton.	Lucien Gove, East Templeton.	—
Oxford, No. 123, . . .	D. M. Howe, Oxford.	A. G. McIntyre, Oxford.	Miss M. B. Fisher, Oxford.
Ashland, No. 124, . . .	C. E. Adams, S. Framingham.	H. A. Dearth, Ashland.	Arthur Stevens, Ashland.
Upton, No. 125, . . .	S. L. Madden, Milford.	George D. Rhodes, Milford.	Miss Myrtice S. King, Upton.
Hubbardston, No. 126, . .	J. F. Flagg, Hubbardston.	J. H. Allen, Hubbardston.	Eva S. Mason, Hubbardston.
Amesbury, No. 127, . .	J. Q. Evans, Amesbury.	Lizzie I. Huntington, Amesbury.	Fred W. Sargent, Amesbury.
North Andover, No. 128, .	Peter Holt, Jr., N. Andover.	Mrs. O. T. Young, North Andover.	Lizzie F. Ingalls, North Andover.
Lincoln, No. 129, . . .	I. C. Foster, Lincoln.	George Ropes, Lincoln.	Helen Weston, Lincoln.
Gardner, No. 130, . . .	W. E. Knight, Gardner.	A. F. Johnson, West Gardner.	Mrs. Vesta A. Knowlton, Gardner.
Boxborough, No. 131, . .	S. B. Hager, W. Acton.	C. T. Wetherbee, Littleton Depot.	A. M. Whitcomb, West Acton.
North Brookfield, No. 132, .	John P. Ranger, N. Brookfield.	W. M. Robinson, Oakham.	George P. Buck, North Brookfield.
West Dedham, No. 133, .	S. C. French, W. Dedham.	W. W. Baker, West Dedham.	Alice E. Draper, West Dedham.
Berlin, No. 134, . . .	F. H. Crossman, Berlin.	Mrs. A. Keyes, Berlin.	P. B. Southwick, Berlin.
Norfolk, No. 135, . . .	N. H. Rockwood, Norfolk.	N. H. Fales, Wrentham.	Rose Whiting, Wrentham.
Ipswich, No. 136, . . .	J. A. Burnham, Ipswich.	Mrs. Alden Story, Ipswich.	Mrs. J. C. Underhill, Ipswich.
East Blackstone, No. 137, .	Adrian Scott, Blackstone.	F. N. Thayer, Blackstone.	Mrs. R. F. Colwell, Blackstone.
Northampton, No. 138, .	D. A. Horton, Northampton.	James Ellsworth, Northampton.	Mrs. Levi Bartlett, Northampton.
East Sandwich, No. 139, .	J. F. Carleton, E. Sandwich.	J. E. Holway, Spring Hill.	Mrs. Abbie M. Holway, E. Sandwich.
West Boxford, No. 140, .	C. A. Andrew, W. Boxford.	Mrs. Annie K. Day, S. Groveland.	Ruth M. Webster, West Boxford.
Montague, No. 141, . .	G. H. Goddard, Montague.	C. S. Raymond, Montague.	F. A. Rist, Miller's Falls.
Bolton, No. 142, . . .	Henry Babcock, Bolton.	Mrs. Mary Mentzer, Bolton.	Mrs. Clara S. Walcott, Bolton.
Mendon, No. 143, . . .	J. J. Nutter, Mendon.	Alanson Taft, Mendon.	A. W. Gaskill, Mendon.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Subordinate Granges. — Con.			
Franklin, No. 144,	E. P. Chapman, Franklin.	Milton Allen, Franklin.	Mrs. Wm. E. Nason, Franklin.
Douglas, No. 145,	V. T. Esten, E. Douglas.	Mrs. Mary A. Richardson, Douglas.	Mrs. Myra L. Esten, East Douglas.
West Newbury, No. 146,	J. C. Tarleton, W. Newbury.	A. L. Moore, West Newbury.	Mrs. R. C. Gowen, West Newbury.
West Springfield, No. 147,	N. T. Smith, W. Springfield.	Mrs. E. A. Waters, Holyoke.	E. T. Sikes, W. Springfield.
Swansea, No. 148,	J. N. Hicks, Swansea Centre.	Abbie A. Williams, Swansea Village.	O. A. Gardner, Box 122, Warren, R. I.
Harvard, No. 149,	A. H. Turner, Harvard.	Mrs. Hattie M. Stone, Still River.	W. E. Blanchard, Ayer.
Concord, No. 150,	G. M. Parker, Bedford.	Miss Lillie M. Palmeter, Concord.	Geo. Buttrick, Concord.
Agawam, No. 151,	W. H. Porter, Agawam.	Miss Nellie E. Campbell, Agawam.	Miss Carrie S. Leonard, Agawam.
East Longmeadow, No. 152,	J. M. Burt, E. Longmeadow.	Mrs. F. C. Davis, E. Longmeadow.	M. H. Pease, E. Longmeadow.
Wilbraham, No. 153,	C. P. Bolles, Wilbraham.	Mrs. W. L. Phelps, Wilbraham.	Miss Ida L. Bolles, Wilbraham.
Haverhill, No. 154,	J. A. Bean, Haverhill.	E. A. Emerson, Haverhill.	I. J. Webster, Haverhill.
Methuen, No. 155,	G. O. Marsh, Methuen.	C. H. T. Mann, Methuen.	J. W. Shirley, Lawrence.
W. Bridgewater, No. 156,	Davis Copeland, Campello.	G. C. Howard, Cochesett.	Chas. R Packard, W. Bridgewater.
Granby, No. 157,	F. A. Forward, Granby.	William S. Clark, Granby.	Minnie M. Whitmarsh, Granby.
"Nemasket" of Middleborough, No. 158,	A. H. Eaton, Middleborough.	Mrs. M. A. Hathaway, Middleboro'.	H. G. Schluster, Middleborough.
"Green River" of Williamstown, No. 159,	S. A. Hickox, So. Williamstown.	Julia B. Hickox, So. Williamstown.	Anna H. Torrey, Williamstown.
South Hadley, No. 160,	E. H. Lyman, South Hadley.	A. L. Wright, South Hadley.	Lucy A. Miller, S. Hadley.
"Laurel" of West Newbury, No. 161,	L. H. Bailey, Artichoke.	Annie L. Rogers, Newburyport.	C. E. Rowell, Artichoke.
Dartmouth, No. 162,	J. W. Howland, Dartmouth.	J. W. Gifford, South Westport.	May L. Devoll, Dartmouth.
Dudley, No. 163,	W. H. Prince, Webster.	I. H. Eastabrook, Webster.	J. J. Gilles, Dudley.
Ware, No. 164,	J. W. Cummings, Ware.	Miss Carrie M. Brown, Ware.	Miss Minnie A. Perkins, Ware.
Hampden, No. 165,	Dr. G. T. Ballard, Hampden.	Mrs. C. H. Burleigh, Hampden.	Mrs. A. J. Tuttle, Hampden.
Wellesley, No. 166,	Thomas Whipple, Wellesley.	N. J. L. Ryder, Wellesley.	Ella C. Lyon, Wellesley Hills.
Rowe, No. 167,	C. C. Wheaton, Zoar.	J. F. Brown, Rowe.	C. A. Brown, Rowe.

Somerset, No. 168,	Joseph Gibbs, Pottersville.	Elisha Orvis, Pottersville.	Susie M. Hathaway, Pottersville.
Lunenburg, No. 169,	James Hildreth 2d, Lunenburg.	Mrs. Lucy H. Perrin, Lunenburg.	Charles E. Cox, Lunenburg.
New Braintree, No. 170,	C. D. Sage, North Brookfield.	J. D. Frost, North Brookfield.	Mattie E. Bush, New Braintree.
Merrimac, No. 171,	R. H. Sargent, Merrimac.	H. R. Sargent, Merrimac.	True Hoyt, Merrimac.
Ashby, No. 172,	J. A. Hayward, Ashby.	Mrs. Ada A. Damon, Ashby.	Henry F. Piper, Ashby.
Hopkinton, No. 173,	L. L. Woolson, Hayden Row.	Mrs. Emma E. Thompson, Woodville.	W. V. Thompson, Woodville.
Brookfield, No. 174,	G. S. Ayer, Brookfield.	E. P. Ayer, Brookfield.	S. S. King, Brookfield.
Athol, No. 175,	Horace Drury 2d, Athol Centre.	L. B. Caswell, Athol.	Sallie S. Whitcomb, Athol Centre.
"Miller's River" of Orange, No. 176,	John Dunbar, Orange.	O. G. Hutchins, Orange.	A. B. Coolidge, Orange.
Sturbridge, No. 177,	H. W. Nichols, Sturbridge.	G. S. Ladd, Sturbridge.	Levi B. Chase, Sturbridge.
Monson, No. 178,	O. Pease, Monson.	C. C. Keep, Monson.	A. M. Beebe, Monson.
Ludlow, No. 179,	C. L. Buell, Ludlow Centre.	W. H. Adams, Ludlow Centre.	Anna S. Fuller, Ludlow Centre.
West Brookfield, No. 180,	H. B. Lynde, West Brookfield.	Mary E. Fairbanks, W. Brookfield.	C. S. Johnson, West Brookfield.
Westport, No. 181,	Cortez Allen, South Westport.	Annie F. Jenney, Central Village.	Frances H. Handy, South Westport.
Southbridge, No. 182,	A. H. Morse, Southbridge.	——	Mary E. Vinton, Southbridge.
Andover, No. 183,	S. H. Boutwell, Lowell.	——	Mrs. Bertha A. Chandler, Andover.
Topsfield, No. 184,	E. L. Wilder, Topsfield.	——	B. J. Balch, Topsfield.

APPENDIX.

CATTLE COMMISSIONERS' REPORT.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

In accordance with legal provisions, the Cattle Commissioners submit their annual report.

During the past year the domestic animals of the State have been exempt from any prevailing contagious or epidemic disease, and our duties have been confined to the extermination of sporadic cases, and prevention of their public contact. Success has crowned the labors of our people who are engaged in the business of rearing and caring for all classes of animals and their products, though the beef market and that of beeves for fattening has not been very remunerative. Boards of health and private individuals have with great frequency notified us of suspected cases of contagious pleuro-pneumonia. These notices are from all parts of the State; but the greater number are from Worcester and the counties east, indicating that pulmonary trouble of some kind is more prevalent there, or that stock owners are more alert in its detection.

Most of the cases have been where but a single animal in a herd was affected; a very few were where suspicion had fallen upon a number in the same herd, and supposed cases of death from this cause had been reported. It should perhaps be said that a certain form of pulmonary trouble is not uncommon among our neat stock; but in its virulence, rapidity of propagation and development, and in its results on a single animal or a herd, it is unlike and less to be feared than contagious pleuro-pneumonia. So far as the commissioners know, there has been but one case of this disease in the State since 1864; and, if we ever have it again, it will not be — it cannot be — by spontaneous generation, but by actual contact of our stock with animals infected with it, which have come to us from abroad, or from some section of our own country where it exists, though more or less concealed from public knowledge. The great trend of cattle movement is along the different trunk railway lines from the West to the Atlantic sea-board; and there will be danger of its appearance here so long as it exists anywhere in the Middle States or at the West. It has been our endeavor to avoid this danger by quarantine regulations, and arrangements made with the U. S. Department of Animal Industry, that all animals coming to us from areas of infection shall be inspected by the veterinary officers of the department, and a permit for transportation given only to such as can receive a clean bill of health. We would not utter a word to encourage our stock owners or boards of health to relax their vigilance in relation to the health of their herds; but, if they would bear in mind the facts here stated, they would see there is no occasion for serious alarm in the many cases to which our attention is called. If the trouble complained of is among their home stock, and they have not been in contact with fresh arrivals from Europe or the West, it cannot be contagious pleuro-pneumonia. Such cases are doubtless pulmonary tuberculosis, a destroying disease, and one to be avoided if possible, but which is of minor importance when compared with the first named.

The attention of our farmers, and of those who consume our stock products, has been called to this disease in several of our former reports. In our last, Dr. Winchester, who was then the veterinarian of the Board, treated of it in an exhaustive manner, giving a minute description of all its lesions, to what extent it was contagious, and its mode of propagation; the danger to humans of consuming the milk or flesh, however slightly the animal might be infected by it; the methods to be pursued to avoid or mitigate this danger; and indicating the methods by which it might be eradicated, or its prevalence materially diminished. All seekers after detailed information respecting it are referred to that report. Should this disease materially increase in those sections of the State where milk is produced for town and city markets, as a measure to guard the public health, it may become the duty of the commissioners or of local boards of health to cause the inspection of herds producing market milk, and the removal therefrom of all animals exhibiting the slightest symptoms of this disease. During the year, cattle commissions and veterinarians at the West have called the attention of the Board to the existence there of a contagious disease technically known as *Actinomycosis* or " lumpy jaw." The disease is comparatively new in this country, and, as it spreads rapidly, is much to be feared, though not so fatal and destructive as diseases of pulmonary organs. On the 7th of March a communication was received conveying the information that a car-load of cattle infected by it, and in which were several advanced cases, had been shipped to the East, and, as was believed, to our State. The information was from such a source that it appeared to be our duty to guard against the danger by seizure and quarantine, when the animals reached our territory. But we failed to find them, and it is more than probable that their owners learned that their reputation had preceded them, and their final destination was changed to some other market. There is no doubt about the character of the disease and its prevalence among cattle in some sections of the West, and the need of watchfulness by our stock owners and officials to prevent its appearance in our State.

Early in July Western officials notified us that Texan cattle, direct from the plains, were being transported in large numbers by the usual channels of transit to the Eastern seaboard, and were leaving a trail of Spanish fever along their routes of travel, to avoid which we must be on our guard. Therefore orders were immediately issued to all our railroad officials whose lines had Western connections and which were used in transporting Western products, to stop all such cattle when they reached our soil within the State lines. This resulted in preventing their appearance here, and we escaped losses from which some of the States suffered.

HORSES.

As in former years, the only contagious disease which has appeared among this class of our animals has been glanders; and the number infected by it which have been destroyed by our order has been fifty-seven, which is fourteen less than the previous year. There have been cases of suspects and others of actual disease which have come to our knowledge. Some of our citizens (as all should) have a great dread of this disease as a source of danger to themselves; and, when informed by a competent veterinarian that they have an animal infected by it, they cause it to be killed at once and their premises to be disinfected, without notifying their Board of Health, as the law requires, and for not doing which it provides a penalty. As the purpose of the law is attained by such a course of action, and more quickly than it could be by notification and the action of the Board of Health and the commissioners, no legal complaints have been made. Yet such a course cannot be recommended or approved, though pursued by those who from principle are law abiding, and desire to see the object secured for which the law is enacted. But all are not thus loyal and kindly disposed. Some of our citizens, possessing animals which for good reasons have fallen under suspicion, neither cause them to be killed or notify their local officials, but "shove them;" and we have reason to believe there have been cases where such acts have been aided or encouraged by members of the veterinary profession. In combating this disease, the course which is the best for the whole community, which in the long run will be most successful, is that which will be in harmony with the letter as well as the spirit of the law. We usually find this disease in sporadic form, but nearly every year meet with what might be called centres of infection, because of their greater frequency. The present year such centre has been in Fall River and its vicinity, but at the present writing the disease there appears to be subdued.

Early in the year letters from Illinois informed us that one hundred mares, which were supposed to be infected with a contagious disease technically known as *Maladie du Coit*, had been shipped to Massachusetts for sale, and warning us against them. If the animals came here, we have been unable to find them as shipped, or with certainty a single animal of the lot. In all essential particulars lesions of this disease are like venereal diseases in humans, and perpetuated in the same way. The history of the disease indicates that first and last it has caused much suffering and inflicted great pecuniary loss, in which some of the Western States have been involved. But efforts for the eradication are now being made there, with good prospect of success. Several suspected cases of this disease were found in Essex County by the veterinary member of our Board, which were examined and placed under surveillance; but the lesions, though somewhat similar, did not develop in typical form, and the watch was withdrawn. To this date it is believed that not a case of the kind has occurred in this State; but our commerce in horses with all parts of the country is so unrestricted that horse breeders need be cautious in selecting both sires and dams which in this respect are in perfect health.

Swine.

There has been less disease among our swine the present year than in previous years of recent date, or else our local officials have been less faithful in reporting their cases. There have doubtless been cases of hog cholera, derived from the usual source of swill containing the germ of the disease from Western cholera pork; but the tendency on the part of swine owners has been to give that name to every disease to which this class of our animals are subject. The regulations made by the Board to prevent the spread of this disease were given in full in our last annual report. They have been kept in force until the present time; and we are satisfied that the prevalence of the disease has not been increased by their enforcement, that substantial justice has been received by our swine owners, and the State saved from much expense which could not be made effective to decrease or exterminate the malady.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
O. B. HADWEN,
Cattle Commissioners.

Boston, Jan. 6, 1890.

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PUBLIC DOCUMENT. No. 33.

SEVENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1889.

BOSTON:
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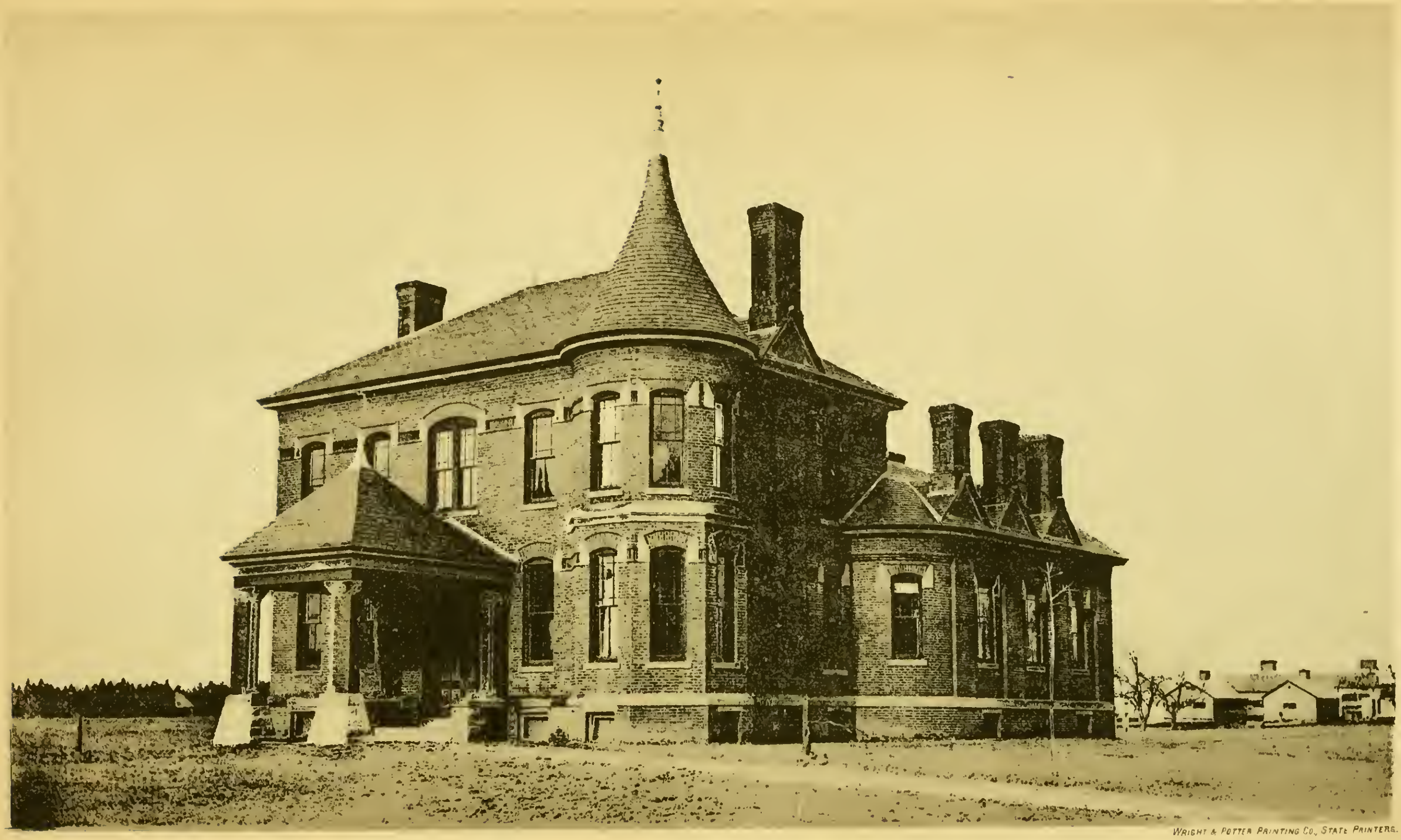
1890.



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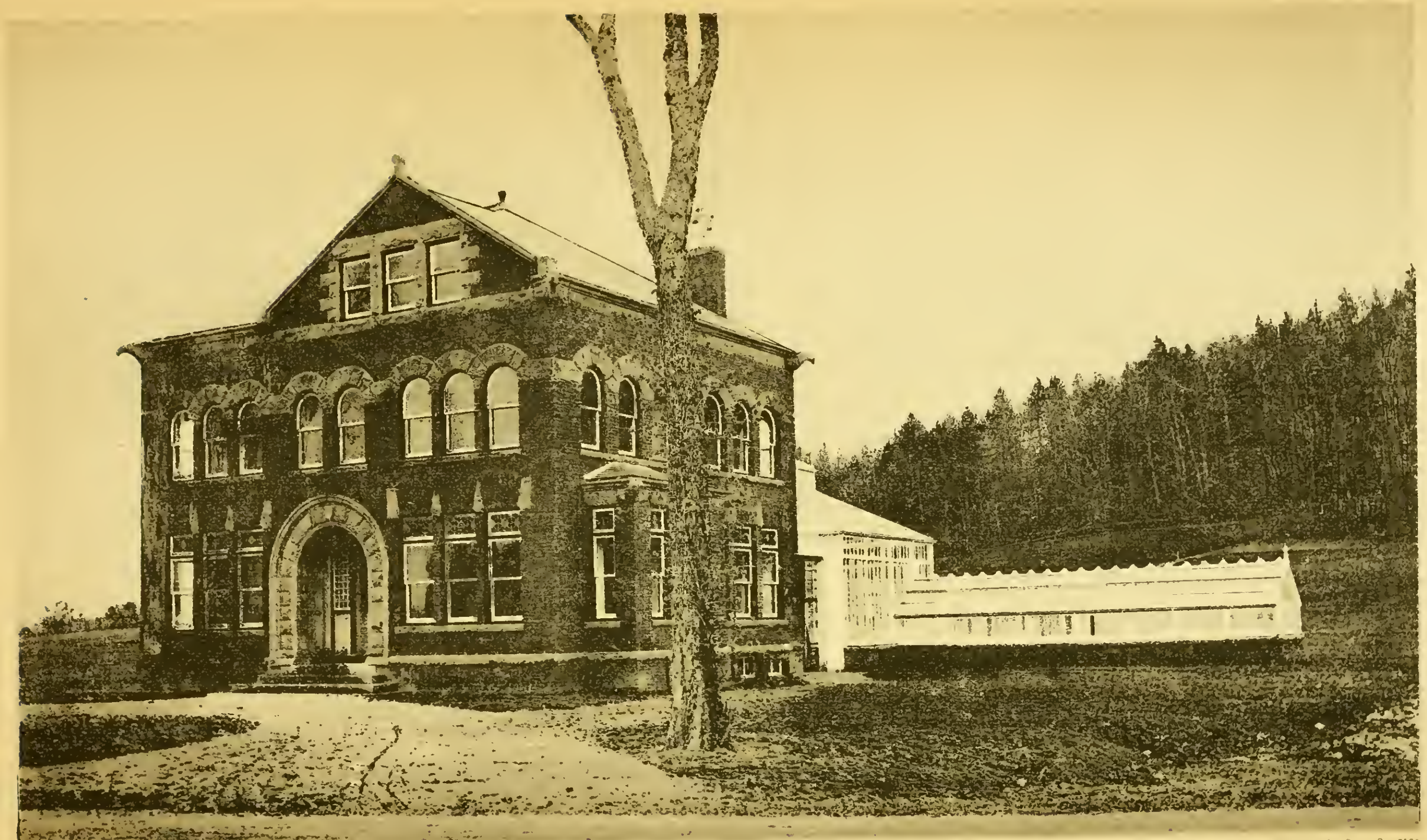

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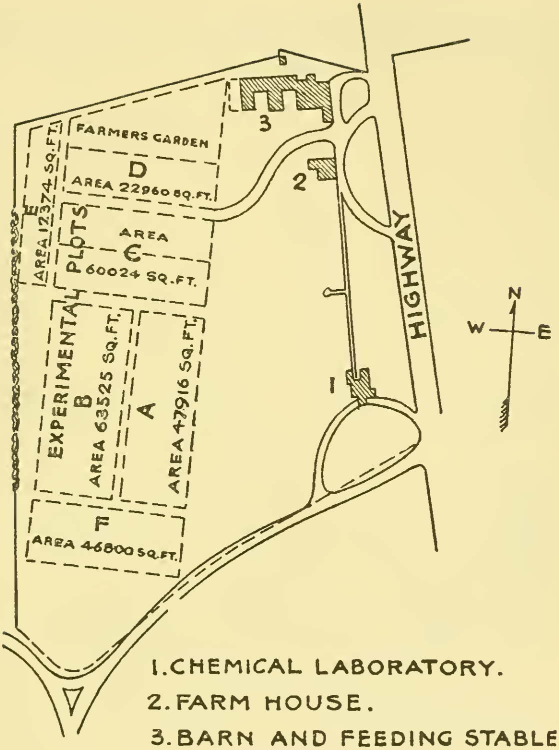
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1. CHEMICAL LABORATORY.
2. FARM HOUSE.
3. BARN AND FEEDING STABLES.

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·MASSACHUSETTS·EXPERIMENT·STATION·
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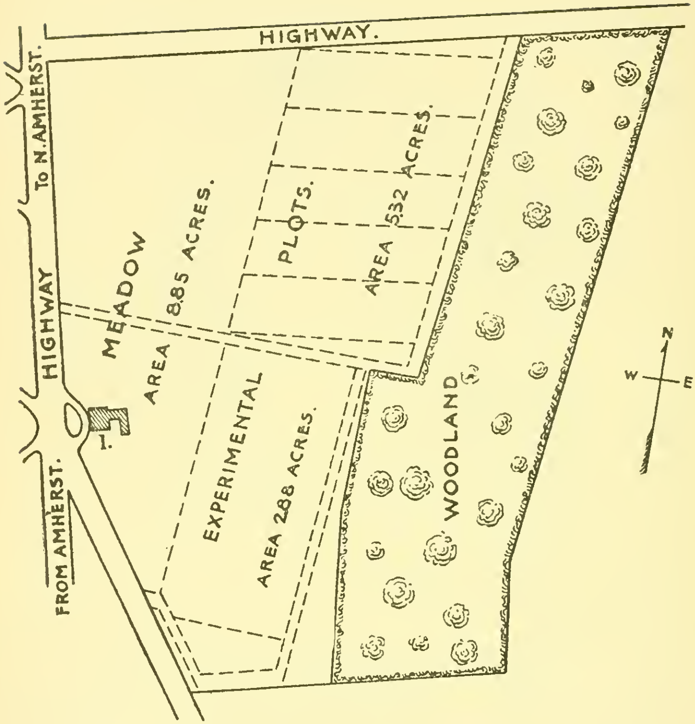
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·FROM·THE·
AGRICULTURAL·COLLEGE·FARM·
·EAST·OF·THE·HIGHWAY·
AREA·TAKEN· 30,52 ACRES·

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

BOARD OF CONTROL, 1889.

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C. S. Crocker, B.S.,	" " "
B. L. Hartwell, B.S.,	" " "
W. A. Parsons, B.S.,	*Field Experiments and Stock Feeding.*
David Wentzell,	*Farmer.*

Boston, Jan. 14, 1890.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882, I have the honor to present the Seventh Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

SEVENTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN : — The past year has been a prosperous one. The State Legislature has granted your application for the appropriation of means to erect suitable buildings required for much-needed investigations into some special features of plant growth and of diseases of agricultural plants. The plans adopted for the construction of an agricultural and physiological laboratory have been successfully carried out, and the building will be shortly ready for occupation. The expenses incurred in carrying on this work are fairly within the sum assigned for that purpose.

No serious loss of any description has happened to the property of the State. The various structures of the station are in a well-preserved condition, and the live stock for experimental purposes is at present more complete as far as the different kinds of farm live stock are concerned than at any previous period.

The experimental work of the year has been, as far as practicable, in conformity with the plans from time to time presented for your endorsement. No material changes have been made in regard to the principal lines of investigations decided upon during the preceding years. The work in the field, in the barn and in the laboratory, has received, as far as practicable, an equal share of attention.

Professor Humphrey has devoted much attention to various subjects in his special line of investigation. A detailed description of his work on fungoidal diseases, etc., prepared by him, forms a part of the accompanying annual report.

The experiments to determine the cost of feed for the production of milk and of pork have been continued, with some modifications; to these have been added of late experiments to ascertain the cost of feed for the production of beef and mutton. A variety of field crops, in particular reputed fodder crops, have been raised for testing their relative feeding value, and to determine their general merits in a mixed farm management. Some of these crops suffered, in common with our grain crops, from exceptionally cool and wet weather during the latter part of June and the months of July and August.

The laboratory work has been exceptionally large and in various directions, in consequence of the additional chemical work called for by the Hatch Experiment Station, and by the State inspection of commercial fertilizers; aside from the numerous applications of farmers, associations, and parties interested in farming, for the examination of fertilizers, fodder articles, well-waters, etc.

The details of the work carried on in the previously stated directions are recorded in the subsequent pages under the following headings: —

FEEDING EXPERIMENTS.

I. Feeding experiments with milch cows, to ascertain the feeding value of fodder corn, corn stover and corn ensilage, as compared with English hay, and also of sugar beets and of carrots.

II. Feeding experiments with milch cows, to ascertain the value of a mixed crop of vetch and oats, of Southern cow-pea and of serradella, when fed as green fodder in part or in the whole for English hay.

III. Financial record of twelve cows, kept at the Massachusetts Experiment Station.

IV. Creamery record of the station during the years 1887, 1888 and 1889; with some observations made during several visits to the farms of one hundred and ninety-three patrons of two creameries in our vicinity.

V. Feeding experiments with pigs; skim milk, barley meal, corn meal, wheat bran and gluten meal serving as fodder ingredients of the daily diet.

FIELD EXPERIMENTS.

VI. Experiments to compare the effect of different forms of nitrogen on the growth, etc., of corn.

VII. Influence of fertilizers on the quantity and quality of fodder crops.

VIII. Experiments with field and garden crops.

IX. Experiments with green crops for summer feed.

X. Professor Humphrey's report: —

1. General account of fungi.
2. Potato scab.
3. Diseases on station farm.
4. Observations of material sent on for examination.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

XI. Analyses of licensed commercial fertilizers.

XII. Miscellaneous analyses of material sent on.

XIII. Water analyses.

XIV. Compilation of fodder analyses, with reference to fodder constituents and fertilizing constituents; analyses of industrial products, garden crops, fruits, etc., made at Amherst, Mass.

XV. Meteorological observations.

The periodical publications of the station have been more numerous than in preceding years, on account of the monthly publications of the analyses of licensed fertilizers required by the new laws for the regulation of the trade of commercial fertilizers. Four bulletins, containing reports of progress on investigations, and six monthly circulars of fertilizer analyses, have been issued. The interest in the publications of the station is steadily growing. From ten to eleven thousand copies have been published of late.

It gives me particular pleasure to acknowledge the valuable assistance rendered by all parties engaged in the work of the station. To their marked industry and faithful execution of the various tasks assigned to them is largely due the successful termination of the work recorded in this report.

Thanking you sincerely for your kind indulgence in the performance of my duties, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,
Director of the Massachusetts Agricultural Experiment Station.

AMHERST, MASS., Jan. 14, 1890.

ON FEEDING EXPERIMENTS.

I. Feeding experiments with milch cows, to determine the value of fodder corn, corn stover and corn ensilage, as compared with English hay; and also of corn ensilage, as compared with that of sugar beets and carrots. The statement closes with a summary of observations in that connection during four successive years, 1885 to 1889.

II. Feeding experiments with milch cows, to ascertain the value of vetch and oats, of cow-pea and of serradella when fed as green fodder in part or in the whole for English hay. The results reported are those of the third year of our trial.

III. Record of twelve cows kept at the Massachusetts Experiment Station.

IV. Creamery record of the station during the years 1887, 1888 and 1889; and some observations made during visits to the patrons of two creameries in our vicinity.

V. Feeding experiments with pigs; skim-milk, barley meal, corn meal, wheat bran and gluten meal serving as fodder ingredients of the daily diet.

VI. Fodder analyses.

I. Record of Feeding Experiments with Milch Cows, to determine the Relative Value of Fodder Corn, Corn Stover and Corn Ensilage, as compared with that of English Hay; and of Corn Ensilage as compared with that of Sugar Beets and of Carrots, under Otherwise Corresponding Circumstances. Fourth Year of Observation, from November, 1888, to May, 1889.

The experiment was conducted upon the same general plan as during the preceding years, the principal object of the investigation remaining the same as stated above. A larger number of cows (nine) than in any of the preceding years took part in the trial; not more, however, than six cows at any one time. Whenever the daily yield of milk of any particular animal fell below from six to seven quarts, on account of advanced milking period, a new-milch cow was substituted, to secure, as far as practicable, corresponding conditions throughout the entire experiment. Grades of various descriptions, yet of a similar quality with regard to the production of quantity and quality of milk, constituted our herd. They varied in age from five to eleven years; the mean in case of nine cows was seven years. Each served from two to seven months for our observation.

The course adopted in preparing the daily diet was essentially the same as in the preceding year. English hay, fodder corn, corn stover, corn ensilage, sugar beets and carrots served as coarse fodder articles; and corn meal, wheat bran and gluten meal as the supplementary feed stuffs to secure the desired relative proportion of digestible nitrogenous to non-nitrogenous substances in the daily fodder rations (commonly called nutritive ratio). The fodder corn, corn stover and corn ensilage were cut to an even length (one and one-half to two inches) before fed. The daily amount of fodder corn left behind unconsumed was, on an average, two and one-half pounds, and that of corn stover and ensilage about three pounds.

The same variety of corn, Pride of the North, a dent corn, served for each trial. The corn ensilage used on these occasions has been produced in every instance from a corn crop of the same variety and the same state of maturity as the one which furnished the dry fodder corn; *i. e.*, at the beginning of the glazing over of the kernels.

The experiment was subdivided into nine feeding periods, extending over a period of seven months. The same quantity of corn meal, wheat bran and gluten meal (three and one-quarter pounds each) was fed daily, from the beginning to the close of the trial. Corn ensilage and roots were fed in different proportions, with one-half or one-fourth of a full English hay ration. Fodder corn and corn stover were fed most of the time by themselves.

The quantity of different fodder rations stated below represents in each case the daily average of the amount actually consumed per head during the entire feeding period. The variations in the daily consumption of the various ingredients of the daily diet in case of different animals were confined entirely to the fodder corn, the corn stover and the corn ensilage, when serving as substitutes in part or in the whole for hay; and to hay, when fed alone as the coarse or bulky part of the daily diet. The amount consumed in that case was controlled by the appetite of the animal, as somewhat larger quantities than the figures represent were offered for their consumption. The daily consumption of the grain feed was limited to the amount stated in each case; the same statement applies to the hay when fed in connection with some other coarse fodder articles, as corn ensilage, sugar beets, etc.

The nutritive ratio of the different diets used varied from 1 : 5.13 to 1 : 6.79. The adopted rates of digestibility of the fodder ingredients are those which have been published of late by E. Wolff. They are in most instances the average values of a series of actual tests, and are for this reason applicable for mere economical questions. As soon as our home observations shall have furnished sufficient material to enable us to establish reliable average values, they will be substituted.

The temporary changes in diet, whenever decided upon, were carried out gradually, as is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates, which accompany all detailed reports in our feeding experiments, past and present, furnish exact figures in that direction. This is in particular the case whenever such statements are of a special interest, for an intelligent appreciation of the final conclusions presented.

The weights of the animals were taken on the same day of each week, before milking and feeding.

The valuation of fodder ingredients is based, in this connection, on the local market price per ton of each article for the period of observation.

Corn meal,	$21 90	Fodder corn,	$5 00
Wheat bran,	20 70	Corn stover,	5 00
Gluten meal,	23 40	Corn ensilage,	2 75
Hay,	15 00	Carrots,	7 00
Rowen,	15 00	Sugar beets,	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4½ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management; while twenty per cent. is assumed to be sold with the milk, and thus lost to the farm.

The obtainable manurial value of the feed consumed during the entire feeding experiment, deducting twenty per cent. for the amount of fertilizing constituents lost in the production of milk, is, at the current market rates, in every instance, more than equal to one-third of the original cost of the feed. In some instances it amounts to more than one-half of the original cost of the feed consumed.

Net cost of feed represents the sum obtained by subtracting eighty per cent. of the commercial value of the fertilizing constituents contained in the fodder consumed, from the total cost of the feed. Nothing but the net cost of feed is considered in the discussion of the cost of production of milk and of cream.

An examination of the subsequent detailed description of the experiment under consideration leads to the same conclusions as our observations in this direction during preceding years: —

1. The high nutritive value of fodder corn, corn stover and good corn ensilage, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animal on trial, as well as the quality and the quantity of the milk obtained, point in that direction.

2. To produce one quart of milk, using the same quantity and quality of grain feed, required in every instance a larger quantity of perfectly dried hay than of either fodder

corn, corn stover or corn ensilage in a corresponding state of dryness, — corn stover leading.

3. The net cost of feed in the case of the same ration of grain feed is from one-third to one-half less per quart of milk, when fodder corn, corn stover or corn ensilage serve as substitutes for English hay in the daily diet of milch cows; corn fodder, as a rule, leading, while corn stover leads the corn ensilage in four out of six cases.

4. Sugar beets, as well as carrots, when fed pound for pound of dry matter in place of part of the hay ration, with the same kind and quantity of grain feed, have raised almost without an exception the temporary yield of milk; exceeding, as a rule, the corn ensilage in that direction.

5. Corn ensilage, as well as roots, proved best when fed in place of one-fourth to one-half of the full hay ration. From twenty-five to twenty-seven pounds of roots, or from thirty-five to forty pounds of corn ensilage, per day, with all the hay called for to satisfy the animal in either case, seems for various reasons a good proportion, allowing the stated kind and quantity of grain feed.

6. The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet. The increase in the quantity of milk is frequently accompanied by a decrease in solids.

Quarts of Milk required to make One Space of Cream. (Average of Six Cows fed upon the Following Rations.)

Hay Period.	Fodder Corn Period.	Corn Stover Period.	Carrot Period.	Corn Ensilage Period.	Sugar Beet Period.
1.98	1.68	1.59	2.16	1.92	1.88

For further details, consult the subsequent record of our experiment (November, 1888, to May, 1889), and also the summary of our investigations during 1885, 1886, 1887, 1888 and 1889, in connection with the subject under discussion.

FEEDING RECORD.

ANNIE: *Age, six years; grade, Jersey; last calf, June 19, 1888.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	18.67	–	–	–	–	–	–	25.84	10.68	2.42	1 : 6.14	830
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	13.27	–	–	–	–	–	17.05	8.51	2.00	1 : 5.44	784
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	14.36	–	–	–	–	15.83	7.09	2.23	1 : 5.66	766
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	37.05	–	–	–	21.55	10.27	2.10	1 : 6.16	808
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5 00	–	–	–	29.91	–	–	20.88	10.10	2.07	1 : 6.34	806
March 1 to March 14, .	3 25	3.25	3.25	15.00	–	–	–	–	–	–	22.46	9.07	2.48	1 : 5.90	842
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.53	–	23.43	10.28	2.28	1 : 6.12	847
April 9 to April 22, .	3.25	3.25	3.25	16 50	–	–	–	–	–	–	23.84	10.20	2.34	1 : 6.00	880
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	16.64	23.49	10.42	2.25	1 : 5.13	888

MAY: *Age, eight years; grade, Jersey; last calf, June 6, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	20.00	–	–	–	–	–	–	27.06	10.13	2.67	1 : 6.22	950
Nov. 20 to Dec. 11, .	3.25	3.25	3 25	–	17.68	–	–	–	–	–	19.84	8.05	2.46	1 : 5.71	907
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	21.82	–	–	–	–	19 55	8 43	2 32	1 : 6.19	902
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.37	–	–	–	21.78	9.53	2.29	1 : 6.20	892
Jan. 29 to Feb. 19, .	3.25	3.25	3 25	5.00	–	–	–	38.86	–	–	23.15	9.13	2.54	1 : 6.66	937
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.33	–	23.41	9.64	2.43	1 : 6.11	930
April 9 to April 22, .	3.25	3.25	3 25	16.93	–	–	–	–	–	–	24.24	9.29	2.61	1 : 6.03	976
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	18.05	24.74	10.01	2.47	1 : 5.18	962

FEEDING RECORD — *Continued.*

EVA: *Age, nine years; grade, Jersey; last calf, Oct. 7, 1888.*

FEEDING PERIODS.	Fred consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	20.00	–	–	–	–	–	–	27.06	14.95	1.81	1 : 6.22	1,018
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	18.23	–	–	–	–	–	20.18	11.76	1.72	1 : 5.70	972
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	19.00	–	–	–	–	18.15	10.84	1.67	1 : 6.00	941
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.35	–	–	–	21.78	12.13	1.80	1 : 6.20	964
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	43.00	–	–	24.21	11.58	2.09	1 : 6.79	980
March 1 to March 14, .	3.23	3.25	3.25	20.43	–	–	–	–	–	–	27.45	10.73	2.49	1 : 6.25	1,025
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	46.20	–	23.77	10.99	2.16	1 : 6.14	992

MELIA: *Age, eleven years; grade, Dutch; last calf, Aug. 5, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	18.73	–	–	–	–	–	–	25.89	9.60	2.70	1 : 6.15	1,063
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	13.45	–	–	–	–	–	17.16	7.17	2.39	1 : 5.45	1,025
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	17.18	–	–	–	–	17.24	6.48	2.66	1 : 5.87	1,027
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.37	–	–	–	21.78	7.66	2.84	1 : 6.20	1,062
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	34.32	–	–	22.00	7.20	3.05	1 : 6.50	1,094

FEEDING RECORD — *Continued.*

DAISY: *Age, six years; grade, Durham; last calf, Jan. 5, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	22.00	–	–	–	–	–	–	28.90	9.87	2.93	1 : 6.34	1,164
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	19.59	–	–	–	–	–	21.04	6.35	3.31	1 : 5.81	1,168
Dec. 17 to Dec. 27, .	3.25	3.25	3.25	–	–	26.36	–	–	–	–	21.82	5.43	4.02	1 : 6.44	1,170
Jan. 3 to Jan. 18, .	3.25	3.25	3.25	10.00	–	–	43.25	–	–	–	22.17	6.09	3.64	1 : 6.26	1,195

MINNIE: *Age, nine years; grade, Ayrshire; last calf, May 3, 1887.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 15, .	3.25	3.25	3.25	17.52	–	–	–	–	–	–	24.78	7.83	3.16	1 : 6.07	1,051
Nov. 20 to Dec. 11, .	3.25	3.25	3.25	–	11.68	–	–	–	–	–	16.05	6.15	2.61	1 : 5.33	1,016

FLORA: *Age, five years; grade, Durham; last calf, Dec. 22, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Jan. 3 to Jan. 21, .	3.25	3.25	3.25	10.00	–	–	39.05	–	–	–	21.75	15.30	1.42	1 : 6.20	900
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	30.91	–	–	21.13	13.31	1.59	1 : 6.38	862
March 1 to March 14, .	3.25	3.25	3.25	14.86	–	–	–	–	–	–	22.33	12.05	1.85	1 : 5.39	877
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	43.47	–	23.43	13.10	1.79	1 : 6.11	873
April 9 to April 22, .	3.25	3.25	3.25	18.21	–	–	–	–	–	–	25.41	13.02	1.95	1 : 6.12	917
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	19.23	25.80	13.37	1.93	1 : 5.21	918

FEEDING RECORD — *Concluded.*

JESSIE: *Age, five years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.										Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.					
1888 and 1889.															
Jan. 29 to Feb. 19, .	3.25	3.25	3.25	5.00	–	–	–	42.09	–	–	23.98	14.12	1.70	1 : 6.76	735
March 1 to March 14, .	3.25	3.25	3.25	15.21	–	–	–	–	–	–	22.66	11.46	1.98	1 : 5.96	736
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	47.47	–	23.94	11.73	2.04	1 : 6.16	734
April 9 to April 22, .	3.25	3.25	3.25	18.93	–	–	–	–	–	–	25.08	12.78	1.96	1 : 6.16	794
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	20.27	26.72	13.23	2.02	1 : 5.24	800

ELSIE: *Age, six years; grade, Dutch; last calf, Feb. 26, 1889.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
March 19 to April 2, .	3.25	3.25	3.25	10.00	–	–	–	–	49.60	–	24.21	13.64	1.78	1 : 6.18	1,112
April 9 to April 22, .	3.25	3.25	3.25	21.32	–	–	–	–	–	–	28.27	12.25	2.31	1 : 6.30	1,115
April 30 to May 21, .	3.25	3.25	3.25	–	–	–	–	–	–	23.45	29.55	12.33	2.39	1 : 5.31	1,128

TOTAL COST OF FEED PER QUART OF MILK.

Annie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	160.25	10.68	48.75	48 75	48.75	280.00	–	–	–	–	–	–	$3 71	2.32
Nov. 20 to Dec. 11, .	187.25	8.51	71.50	71.50	71.50	–	302.00	–	–	–	–	–	3 11	1.66
Dec. 17 to Dec. 27, .	78.00	7.09	35 75	35.75	35.75	–	–	158 00	–	–	–	–	1 58	2.02
Jan. 3 to Jan. 21, .	195.25	10.27	61.75	61.75	61 75	190.00	–	–	704.00	–	–	–	5 93	3.04
Jan. 29 to Feb. 19, .	222.25	10.10	71.50	71.50	71.50	110 00	–	–	–	659.00	–	–	4 09	1.84
March 1 to March 14, .	127.00	9.07	45.50	45.50	45.50	210.00	–	–	–	–	–	–	3 08	2 43
March 19 to April 2, .	154.13	10.28	48.75	48 75	48 75	150.00	–	–	–	–	653 00	–	4 37	2.84
April 9 to April 22, .	142.75	10.20	45.50	45.50	45.50	231.00	–	–	–	–	–	–	3 23	2 26
April 30 to May 21, .	229.25	10.42	71.50	71.50	71.50	–	–	–	–	–	–	366 00	5 10	2.22

May.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	152.00	10.13	48.75	48.75	48.75	300.00	–	–	–	–	–	–	$3 86	2.54
Nov. 20 to Dec. 11, .	177.00	8.05	71 50	71 50	71.50	–	389.00	–	–	–	–	–	3 33	1.88
Dec. 17 to Dec 27, .	92 75	8.43	35.75	35 75	35.75	–	–	240.00	–	–	–	–	1 78	1.92
Jan. 3 to Jan. 21, .	181.00	9.53	61 75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	3.36
Jan. 29 to Feb. 19, .	200.75	9.13	71.50	71.50	71.50	110.00	–	–	–	855.00	–	–	4 36	2.17
March 19 to April 2, .	144.63	9.64	48.75	48.75	48.75	150.00	–	–	–	–	650.00	–	4 36	3.01
April 9 to April 22, .	130.13	9.29	45.50	45 50	45.50	237.00	–	–	–	–	–	–	3 28	2 52
April 30 to May 21, .	220.25	10.01	71.50	71.50	71 50	–	–	–	–	–	–	397.00	5 34	2.42

Total Cost of Feed per Quart of Milk — *Continued.*

Eva.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	224 25	14.95	48.75	48.75	48.75	300.00	–	–	–	–	–	–	$3 86	1.72
Nov. 20 to Dec. 11, .	258 75	11.76	71.50	71.50	71 50	–	401.00	–	–	–	–	–	3 36	1 30
Dec. 17 to Dec. 27, .	119.25	10.84	35.75	35.75	35.75	–	–	209.00	–	–	–	–	1 70	1.43
Jan. 3 to Jan. 21, .	230 50	12.13	61.75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	2.64
Jan. 29 to Feb. 19, .	251.75	11.58	71.50	71.50	71.50	110.00	–	–	–	946.00	–	–	4 49	1.76
March 1 to March 14, .	150.25	10.73	45.50	45.50	45.50	286.00	–	–	–	–	–	–	3 65	2.43
March 19 to April 2, .	164.88	10.99	48.75	48 75	48.75	150.00	–	–	–	–	693.00	–	4 47	2 71
Melia.														
Nov. 1 to Nov. 15, .	144 00	9.60	48.75	48.75	48.75	281.00	–	–	–	–	–	–	$3 76	2.58
Nov. 20 to Dec. 11, .	157.75	7.17	71.50	71.50	71.50	–	296.00	–	–	–	–	–	3 10	1.97
Dec. 17 to Dec. 27, .	71.25	6.48	35.75	35.75	35.75	–	–	189.00	–	–	–	–	1 65	2.32
Jan. 3 to Jan. 21, .	145.50	7.66	61.75	61.75	61.75	190.00	–	–	748.00	–	–	–	6 08	4.18
Jan. 29 to Feb. 19, .	158.50	7.20	71.50	71.50	71.50	110.00	–	–	–	755.00	–	–	4 22	2.66

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Daisy.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Nov. 1 to Nov. 15, .	148.00	9.87	48.75	48.75	48.75	330.00	–	–	–	–	–	–	$4 08	2 76
Nov. 20 to Dec. 11, .	139.75	6.35	71.50	71.50	71 50	–	431.00	–	–	–	–	–	3 44	2.46
Dec. 17 to Dec. 27, .	59.75	5 43	35.75	35.75	35.75	–	–	290.00	–	–	–	–	1 90	3.18
Jan. 3 to Jan. 18, .	97.50	6.09	52.00	52.00	52.00	160.00	–	–	692.00	–	–	–	5 34	5.48

Minnie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Nov. 1 to Nov. 15, .	117.50	7.83	48.75	48.75	48.75	262.75	–	–	–	–	–	–	$3 58	3.05
Nov. 20 to Dec. 11, .	135.25	6.15	71.50	71.50	71.50	–	257.00	–	–	–	–	–	3 00	2.22

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Flora.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
Jan. 3 to Jan. 21, .	290.75	15.30	61.75	61.75	61.75	190.00	–	–	742.00	–	–	–	$6 06	2.08
Jan. 29 to Feb. 19, .	292.75	13.31	71.50	71.50	71.50	110.00	–	–	–	680.00	–	–	4 12	1.41
March 1 to March 14, .	168.63	12.05	45.50	45.50	45.50	208.00	–	–	–	–	–	–	3 06	1.81
March 19 to April 2, .	196.50	13.10	48.75	48.75	48.75	150.00	–	–	–	–	653.00	–	4 37	2.22
April 9 to April 22, .	182 25	13.02	45.50	45.50	45.50	255.00	–	–	–	–	–	–	3 41	1.87
April 30 to May 21, .	294.13	13.37	71.50	71.50	71.50	–	–	–	–	–	–	423 00	5 53	1.88

Jessie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
Jan. 29 to Feb. 19, .	310.75	14.12	71.50	71.50	71.50	110.00	–	–	–	926 00	–	–	$4 46	1.43
March 1 to March 14, .	160.50	11.46	45.50	45.50	45.50	213.00	–	–	–	–	–	–	3 10	1.93
March 19 to April 2, .	176.00	11.73	48.75	48.75	48.75	150.00	–	–	–	–	712.00	–	4 51	2 56
April 9 to April 22, .	178.88	12.78	45.50	45 50	45 50	265.00	–	–	–	–	–	–	3 49	1.95
April 30 to May 21, .	291.12	13.23	71.50	71.50	71.50	–	–	–	–	–	–	446.00	5 70	1.96

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Elsie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Fodder Corn consumed.	Total Amount of Corn Stover consumed.	Total Amount of Carrots consumed.	Total Amount of Corn Ensilage consumed.	Total Amount of Sugar Beets consumed.	Total Amount of Rowen consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1888 and 1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
March 19 to April 2, .	204.63	13 64	48 75	48.75	48.75	150.00	–	–	–	–	744.00	–	$4 59	2.24
April 9 to April 22, .	171 50	12.25	45.50	45.50	45.50	298.50	–	–	–	–	–	–	3 74	2 18
April 30 to May 21, .	272.25	12.33	71.50	71.50	71.50	–	–	–	–	–	–	516.00	6 23	2.29

Valuation of Essential Fertilizing Constitutents contained in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents. (1889.)
[Per cent.]

	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Fodder Corn.	Corn Stover.	Carrots.	Corn Ensilage.	Sugar Beets.	Rowen.
Moisture, . .	12.890	10.080	10.220	8.060	36.850	50.130	90.050	74.760	87.210	10.950
Nitrogen, . .	1.550	2.556	4.330	1.480	.992	.638	.127	.331	.208	2.030
Phosphoric acid,	.713	2.900	.392	.112	.367	.133	.100	.138	.086	.351
Potassium oxide,	.430	1.637	.049	.457	.801	.976	.070	.301	.462	2.794
Valuation per 2,000 pounds,	$6 51	$13 64	$15 23	$5 58	$4 53	$3 21	$0 62	$1 56	$1 23	$9 83

NET COST OF MILK AND MANURIAL VALUE OF FEED.

Annie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 71	$1 64	$1 31	$2 40	1.50	825
Nov. 20 to Dec. 11, .	3 11	1 95	1 56	1 55	0.83	790
Dec. 17 to Dec. 27, .	1 58	89	71	87	1.12	772
Jan. 3 to Jan. 21, .	5 93	1 84	1 47	4 46	2.28	812
Jan. 29 to Feb. 19, .	4 09	2 09	1 67	2 42	1.09	812
Mar. 1 to Mar. 14, .	3 08	1 39	1 11	1 97	1.55	845
Mar. 19 to Apr. 2, .	4 37	1 68	1 34	3 03	1.96	859
Apr. 9 to Apr. 22, .	3 23	1 45	1 16	2 07	1.45	895
Apr. 30 to May 21, .	5 10	3 07	2 46	2 64	1.15	890
Total, . .	$34 20	$16 00	$12 79	$21 41	–	–

Net Cost of Milk and Manurial Value of Feed — *Continued.*

May.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 86	$1 70	$1 36	$2 50	1.64	950
Nov. 20 to Dec. 11, .	3 33	2 14	1 71	1 62	.92	900
Dec. 17 to Dec. 27, .	1 78	1 02	81	97	1.05	907
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	2.54	911
Jan. 29 to Feb. 19, .	4 36	2 24	1 79	2 57	1.28	940
Mar. 19 to Apr. 2, .	4 36	1 68	1 34	3 02	2.09	935
Apr. 9 to Apr. 22, .	3 28	1 47	1 18	2 10	1.61	990
Apr. 30 to May 21, .	5 34	3 22	2 58	2 76	1.25	935
Total, . .	$32 39	$15 33	$12 26	$20 13	-	-
Eva.						
Nov. 1 to Nov. 15, .	$3 86	$1 70	$1 36	$2 50	1.11	1,020
Nov. 20 to Dec. 11, .	3 36	2 17	1 74	1 62	.63	958
Dec. 17 to Dec. 27, .	1 70	97	78	92	.77	940
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	1.99	970
Jan. 29 to Feb. 19, .	4 49	2 31	1 85	2 64	1.04	978
Mar. 1 to Mar. 11, .	3 65	1 60	1 28	2 37	1.58	1,030
Mar. 19 to Apr. 2, .	4 47	1 70	1 36	3 11	1.89	1,000
Total, . .	$27 61	$12 31	$9 86	$17 75	-	-
Melia.						
Nov. 1 to Nov. 15, .	$3 72	$1 65	$1 32	$2 40	1.67	1,075
Nov. 20 to Dec. 11, .	3 10	1 93	1 54	1 56	.99	1,036
Dec. 17 to Dec. 27, .	1 65	94	75	90	1.26	1,025
Jan. 3 to Jan. 21, .	6 08	1 86	1 49	4 59	3.15	1,075
Jan. 29 to Feb. 19, .	4 22	2 16	1 73	2 49	1.57	1,096
Total, . .	$18 77	$8 54	$6 83	$11 94	-	-
Daisy.						
Nov. 1 to Nov. 15, .	$4 08	$1 78	$1 42	$2 66	1.80	1,170
Nov. 20 to Dec. 11, .	3 44	2 24	1 79	1 65	1.18	1,165
Dec. 17 to Dec. 27, .	1 90	1 10	88	1 02	1.71	1,176
Jan. 3 to Jan. 18, .	5 34	1 58	1 26	4 18	4.29	1,220
Total, . .	$14 76	$6 70	$5 35	$9 41	-	-

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Minnie.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at close of Period.
1888 and 1889.					Cents.	Lbs.
Nov. 1 to Nov. 15, .	$3 58	$1 60	$1 28	$2 30	1.96	1,050
Nov. 20 to Dec. 11, .	3 00	1 85	1 48	1 52	1.12	1,017
Total, . .	$6 58	$3 45	$2 76	$3 82	–	–

Flora.

Jan. 3 to Jan. 21, .	$6 06	$1 85	$1 48	$4 58	1.58	882
Jan. 29 to Feb. 19, .	4 12	2 10	1 68	2 44	.83	859
Mar. 1 to Mar. 14, .	3 06	1 39	1 11	1 95	1.16	870
Mar. 19 to Apr. 2, .	4 37	1 68	1 34	3 03	1.54	875
Apr. 9 to Apr 22, .	3 41	1 52	1 22	2 19	1.20	927
Apr. 30 to May 21, .	5 53	3 34	2 67	2 86	.97	918
Total, . .	$26 55	$11 88	$9 50	$17 05	–	–

Jessie.

Jan. 29 to Feb. 19, .	$4 46	$2 29	$1 83	$2 63	0.85	736
Mar. 1 to Mar. 14, .	3 10	1 40	1 12	1 98	1.23	730
Mar. 19 to Apr. 2, .	4 51	1 72	1 38	3 13	1.78	751
Apr. 9 to Apr. 22, .	3 49	1 54	1 23	2 26	1.26	806
Apr. 30 to May 21, .	5 70	3 47	2 78	2 92	1.00	809
Total, . .	$21 26	$10 42	$8 34	$12 92	–	–

Elsie.

Mar. 19 to Apr. 2, .	$4 59	$1 74	$1 39	$3 20	1.56	1,105
Apr. 9 to Apr. 22, .	3 74	1 64	1 31	2 43	1.12	1,120
Apr. 30 to May 21, .	6 23	3 80	3 04	3 19	1.17	1,120
Total, . .	$14 56	$7 18	$5 74	$8 82	–	–

ANALYSES OF MILK.

[Per cent.]

Annie.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids,	13.68	15.22	14.83	14.10	14.30	14.25	14.52	14.06	14.18
Fat,	3.65	5.10	4.90	4.10	4.55	4.61	4.72	4.60	4.67
Solids not fat,	10.03	10.12	9.93	10.00	9.75	9.64	9.80	9.46	9.51
May.									
Solids,	14.90	14.42	15.37	15.42	15.05	–	15.02	15.24	14.61
Fat,	4.13	5.30	4.74	4.60	4.65	–	4.60	5.20	4.87
Solids not fat,	10.77	9.12	10.63	10.82	10.40	–	10.42	10.04	9.74
Eva.									
Solids,	14.40	14.45	15.11	14.90	14.95	15.52	15.63	–	–
Fat,	4.85	5.25	5.17	4.82	4.95	5.51	5.33	–	–
Solids not fat,	9.55	9.20	9.94	10.08	10.00	10.01	10.30	–	–
Melia.									
Solids,	13.82	13.87	14.40	13.86	13.30	–	–	–	–
Fat,	3.70	4.38	4.34	3.50	3.80	–	–	–	–
Solids not fat,	10.12	9.49	10.06	10.36	9.50	–	–	–	–
Daisy.									
Solids,	15.48	14.18	16.70	15.73	–	–	–	–	–
Fat,	4.44	4.48	4.93	3.24	–	–	–	–	–
Solids not fat,	11.04	9.70	11.77	12.49	–	–	–	–	–
Minnie.									
Solids,	14.22	14.07	–	–	–	–	–	–	–
Fat,	4.49	4.85	–	–	–	–	–	–	–
Solids not fat,	9.73	9.22	–	–	–	–	–	–	–

ANALYSES OF MILK — *Concluded.*

Flora.

1888 and 1889.	Nov. 14.	Dec. 4.	Dec. 24.	Jan. 16.	Feb. 11.	Mar. 11.	Apr. 2.	Apr. 16.	May 7.
Solids, . .	–	–	–	12.90	12.77	13.15	13.17	12.57	12.77
Fat, . . .	–	–	–	3.15	3.55	3.68	3.73	3.40	3.46
Solids not fat, .	–	–	–	9.75	9.22	9.47	9.44	9.17	9.31

Jessie.

Solids, . .	–	–	–	–	13.22	13.75	15.12	14.91	15.00
Fat, . . .	–	–	–	–	4.25	4.57	5.34	5.45	4.67
Solids not fat, .	–	–	–	–	8.97	9.18	9.78	9.46	10.33

Elsie.

Solids, . .	–	–	–	–	–	–	12.20	12.75	12.65
Fat, . . .	–	–	–	–	–	–	3.14	3.09	3.38
Solids not fat, .	–	–	–	–	–	–	9.06	9.66	9.27

Analyses of Fodder Articles fed during the Previously Described Feeding Experiments. (November, 1888, to May, 1889.)

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.89	257.80	–	–	1 : 9.01
Dry matter,	87.11	1,742.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.36	27.20	–	–	
" cellulose,	1.90	38.00	12.92	34	
" fat,	4.16	83.20	63.23	76	
" protein (nitrogenous matter),	11.12	222.40	189.04	85	
Non-nitrogenous extract matter,	81.46	1,629.20	1,531.45	94	
	100.00	2,000.00	1,796.64	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.08	201.60	–	–	1 : 3.80
Dry matter,	89.92	1,798.40	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.38	127.60	–	–	
" cellulose,	10.74	214.80	42.96	20	
" fat,	4.34	86.80	69.44	80	
" protein (nitrogenous matter),	17.77	355.40	312.75	88	
Non-nitrogenous extract matter,	60.77	1,215.40	972.32	80	
	100.00	2,000.00	1,397.47	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.22	204.40	–	–	1 : 2.74
Dry matter, . . .	89 78	1,795.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.52	10.40	–	–	
" cellulose, . . .	.56	11.20	3.81	34	
" fat, ...	5.50	110.00	83.60	76	
" protein (nitrogenous matter), . .	30.15	603.00	512.55	85	
Non-nitrogenous extract matter, ...	63.27	1,265.40	1,189.48	94	
	100.00	2,000.00	1,789.44	–	

Hay.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.06	161.20	–	–	1 : 9.05
Dry matter, . . .	91.94	1,838 80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6 67	133.40	–		
" cellulose, . . .	33.75	675.00	391.50	58	
" fat, ...	2.09	41 80	19 23	46	
" protein (nitrogenous matter), . .	10.06	201.20	114.68	57	
Non-nitrogenous extract matter, ...	47.43	948.60	597.62	63	
	100.00	2,000.00	1,123.03	–	

Analyses of Fodder Articles fed, etc. — *Continued.*

Corn Fodder.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	36.85	737.00	–	–	1 : 8.46
Dry matter,	63.15	1,263.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	4.84	96.80	–	–	
“ cellulose,	21.96	439.20	316.22	72	
“ fat,	2.02	40.40	30.30	75	
“ protein (nitrogenous matter),	9.82	196.40	143.37	73	
Non-nitrogenous extract matter,	61.36	1,227.20	822.22	67	
	100.00	2,000 00	1,312.11	–	

Corn Stover.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	50.13	1,002.60	–	–	1 : 10.78
Dry matter,	49.87	997.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	3.73	74.60	–	–	
“ cellulose,	34.49	689.80	496.66	72	
“ fat,	1.75	35.00	26.25	75	
“ protein (nitrogenous matter),	8.00	160.00	116.80	73	
Non-nitrogenous extract matter,	52.03	1,040.60	697.20	67	
	100.00	2,000.00	1,336.91	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Carrots (Danvers).

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	90.05	1,801.00	–	–	1 : 9.17
Dry matter, . . .	9.95	199.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	8.28	165.60	–	–	
" cellulose, . . .	10.26	205.20	205.20	100	
" fat, ...	1.67	33.40	33.40	100	
" protein (nitrogenous matter), . .	7.98	159.60	159.60	100	
Non-nitrogenous extract matter, ...	71.81	1,436.20	1,436.20	100	
	100.00	2,000.00	1,834.40	–	

Corn Ensilage.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	74.56	1,491.20	–	–	1 : 11.72
Dry matter, . . .	25.44	508.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.07	21.40	–	–	
" cellulose, . . .	20.11	402.20	289.58	72	
" fat, ...	6.49	129.80	97.35	75	
" protein (nitrogenous matter), . .	8.14	162.80	118.84	73	
Non-nitrogenous extract matter, ...	64.19	1,283.80	860.15	67	
	100.00	2,000.00	1,365.92	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Continued.*

Sugar Beets (Average).

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	87.21	1,744.20	–	–	1 : 8.36
Dry matter,	12.79	255.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.47	129.40	–	–	
" cellulose,	6.16	123.20	123.20	100	
" fat,	.98	19.60	19.60	100	
" protein (nitrogenous matter),	10.15	203.00	203.00	100	
Non-nitrogenous extract matter,	76.24	1,524.80	1,524.80	100	
	100.00	2,000.00	1,870.60	–	

Rowen.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.95	219.00	–	–	1 : 6.28
Dry matter,	89.05	1,781.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.49	129.80	–	–	
" cellulose,	31.50	630.00	365.40	58	
" fat,	5.03	100.60	46.28	46	
" protein (nitrogenous matter),	14.25	285.00	162.45	57	
Non-nitrogenous extract matter,	42.73	854.60	538.40	63	
	100.00	2,000.00	1,110.53	–	

ANALYSES OF FODDER ARTICLES FED, ETC. — *Concluded.*

Corn Fodder.

[Mostly stalks; left uneaten by the cows during experiment.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	53.70	1,074.00	–	–	1 : 13.92
Dry matter, . . .	46.30	926 00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	3.44	68.80	–	–	
" cellulose, . . .	39.31	786.20	566.06	72	
" fat, ...	2.83	56.60	42.45	75	
" protein (nitrogenous matter), . .	6.47	129.40	94.46	73	
Non-nitrogenous extract matter, ...	47.95	959.00	642.53	67	
	100.00	2,000.00	1,345.50	–	

Corn Stover.

[Mostly stalks; left uneaten by the cows during experiment.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	62.85	1,257.00	–	–	1 : 15 30
Dry matter, . . .	37.15	743.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	2.36	47.20	–	–	
" cellulose, . . .	37.52	750.40	540.29	72	
" fat, ...	3.50	70.00	52.50	75	
" protein (nitrogenous matter), . .	5.94	118.80	86.72	73	
Non-nitrogenous extract matter, ...	50.68	1,013.60	679.11	67	
	100.00	2,000.00	1,358.62	–	

SUMMARY OF FEEDING EXPERIMENTS WITH MILCH COWS.
(NOVEMBER, 1885, TO MAY, 1889.)

Fodder Corn, Corn Stover and Corn Ensilage vs. English Hay.

In preceding communications it will be found that some years ago, November, 1885, a series of observations with milch cows was inaugurated at our institution, for the purpose of securing, under well-defined circumstances, information needed to assist in answering the following questions: —

1. What is the comparative feeding effect of dry fodder corn, of dry corn stover, and of a good corn ensilage, when used in part or in the whole as a substitute for English hay (upland meadow hay) in the daily diet of milch cows, and also that of a good root crop in place of corn ensilage; the amount and kind of grain feed remaining, for obvious reasons, the same under otherwise corresponding circumstances?

2. What is the *total cost*, as well as the *net cost* of the *daily feed* per head in case of different fodder combinations used; making in all cases alike an allowance of a loss of twenty per cent. of the fertilizing constituents contained in the feed consumed, in consequence of the sale of the milk?

3. What is the commercial value, at current market rates, of the manurial refuse obtainable in the case of different fodder combinations used as daily diet for the support of cows, assuming that eighty per cent. of the value of the fertilizing constituents contained in the fodder consumed can be secured to the farm by a careful management?

The results of experiments carried on in this connection during a number of months of the years 1885, 1886, 1887 and 1888, have already been described in detail in our respective annual reports and periodical bulletins. More recent observations in the same direction are reported upon some preceding pages.

As a careful consideration of all our results to date leads practically to the same conclusions, the subsequent final summary of our work has been prepared with a view of enabling, as far as practicable, all parties interested in our special line of inquiry into the economy of milk production to draw their own conclusions, and to ascertain for themselves whether the stand-point taken in our several reports, of progress, is justifiable by the facts presented.

RECORD OF FEEDING EXPERIMENTS.

*November, 1885, to May, 1889.**

Period of Observation.	Fodder Articles consumed, and Their Cost per Ton.		Nutritive Character of Feed (Nutritive Ratio).	Names of Cows on Trial.	Variations in the Daily Yield of Milk (Quarts).	Average Production of Milk per Day during the Entire Period (Quarts).	Variations in the Total Cost of Feed per Quart of Milk produced (Cents).	Variations in the Net Cost of Feed per Quart of Milk produced (Cents).	Variations in the Amount of Dry Matter in the Feed consumed per Quart of Milk (Pounds).
Nov. 20, 1885, to July 4, 1886.	Corn meal, Wheat bran, English hay, Corn stover, Corn ensilage, Sugar beets,	$23 00 20 00 15 00 5 00 2 75 5 00	1 : 6.7 to 1 : 10.17 Mean, 1 : 7.86	1. Daisy (1) 2. Mollie	16.3 – 8.4 12.62– 8.60	12.77 11.00	.97–2.64 1.02–2.50	.50–1.64 .51–1.61	1.44–2.86 1.56–2.80
Oct. 1, 1886, to April 24, 1887.	Corn meal, Wheat bran, Gluten meal, Rye middlings, English hay, Corn stover, Corn ensilage, Carrots,	$23 00 20 00 23 00 24 00 15 00 5 00 2 75 7 00	1 : 5.99 to 1 : 7.90 Mean, 1 : 6 60	1. Susie 2. Meg 3. Dora	13.5 – 9.4 13.9 –10.3 16.3 –11.7	11.92 11.93 13.94	1.04–2.37 .95–2.76 .85-2.26	.43–1.67 .41–1.96 .34–1.60	1.66–2.76 1.72–2.43 1.58–2.23

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* For more details, consult the respective annual reports on the work of this station.

RECORD OF FEEDING EXPERIMENTS.

*November, 1885, to May, 1889.**

Period of Observation.	Fodder Articles consumed, and Their Cost per Ton.		Nutritive Character of Feed (Nutritive Ratio).	Names of Cows on Trial.	Variations in the Daily Yield of Milk (Quarts).	Average Production of Milk per Day during the Entire Period (Quarts).	Variations in the Total Cost of Feed per Quart of Milk produced (Cents).	Variations in the Net Cost of Feed per Quart of Milk produced (Cents).	Variations in the Amount of Dry Matter in the Feed consumed per Quart of Milk (Pounds).
Jan. 8, 1888, to May 15, 1888.	Corn meal,	$23 00		1. May (1)	12.3–10.1	11.23	1.51–2.51	.77–1.63	1.94–2.50
	Wheat bran,	20 70		2. Minnie (1)	12.7–10.2	11.49	1.40–2.53	.74–1.65	1.73–2.52
	Gluten meal,	27 00		3. Melia (1)	14.6–10.9	12.62	1.28–2.44	.66–1.59	1.73–2.43
	Corn and cob meal,	20 70	1 : 5.20 to 1 : 6.10	4. Eva (1)	7.2– 5.5	6.22	2.58–4.74	1.39–3.09	3.36–4.74
	English hay,	15 00	Mean, 1 : 5.80	5. Lizzie	10.6– 7.9	9.06	1.68–3.36	.95–2.19	2.17–3.35
	Corn stover,	5 00		6. Daisy (2)	19.2–13.5	16.22	1.01–1.97	.50–1.28	1.38–1.96
	Corn ensilage,	2 75							
	Fodder corn,	5 00							
Nov. 1, 1888, to May 21, 1889.	Corn meal,	$21 90		1. Annie	10.68– 7.09	9.65	1.66–3.04	.83–2.28	2.00–2.48
	Wheat bran,	20 70		2. May (2)	10.13– 8.05	9.21	1.88–3.36	.92–2.54	2.29–2.67
	Gluten meal,	23 40		3. Eva (2)	14.95–10.73	11.79	1.30–2.72	.63–1.99	1.67–2.49
	English hay,	15 00		4. Daisy (3)	9.87– 5.43	6.95	2.46–5.48	1.18–4.29	2.93–4.04
	Fodder corn,	5 00	1 : 5.13 to 1 : 6.79	5. Jessie	14.12–11.46	12.84	1.43–2.56	.85–1.78	1.70–2.04
	Corn stover,	5 00	Mean, 1 : 6.02	6. Melia (2)	9.60– 7.17	7.05	1.97–4.18	.99–3.15	2.39–3.05
	Corn ensilage,	2 75		7. Elsie	13.64–12.25	12.71	2.18–2.29	1.17–1.56	1.78–2.39
	Carrots,	7 00		8. Minnie (2)	7.83– 6.15	6.83	2.22–3.05	1.12–1.96	2.61–3.16
	Sugar beets,	5 00		9. Flora	15.30–12.05	13.82	1.41–2.22	.83–1.58	1.42–1.95
	Rowen,	15 00							

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* For more details, consult the respective annual reports on the work of this station.

A short discussion of the most important facts presented in the preceding tabular statement may assist in a desirable appreciation of the questions involved.

During our first year of observation, November, 1885, to July, 1886, either corn meal and wheat bran or wheat bran alone served as grain feed; while, during the succeeding years, as a rule, the same weight parts of corn meal, wheat bran and gluten meal were fed.

The above-stated variations of daily yield of milk refer to the highest and lowest yield in each case, and do not bear a direct relation to any particular diet.

The valuation of the fodder ingredients is based in this connection on the average of the local market price per ton of each article for the entire period of observation.

Corn meal,	$22 75	Fodder corn,	$5 00
Wheat bran,	21 00	Corn stover,	5 00
Gluten meal,	24 50	Corn ensilage,	2 75
Hay,	15 00	Carrots,	7 00
Rowen,	15 00	Sugar beets,	5 00

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4¼ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management, while twenty per cent. is assumed to be sold with the milk.

PRINCIPAL DAILY FODDER RATIONS USED.

November, 1885, to July, 1886.

1.		2.	
Corn meal,	3.25 lbs.	Corn meal,	3.25 lbs.
Wheat bran,	3.25 "	Wheat bran,	3.25 "
Hay,	21.75 "	Hay,	10.00 "
Total cost,	23.43 cts.	Corn stover,	8.00 "
Net cost,	15.43 "	Total cost,	16.62 cts.
Manurial value obtainable,	8.00 "	Net cost,	10.04 "
Nutritive ratio,	1 : 8.02	Manurial value obtainable,	6.58 "
		Nutritive ratio,	1 : 7.83

PRINCIPAL DAILY FODDER RATIONS USED — *Continued.*

3.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	5 00 "
Corn stover,	12.75 "
Total cost,	14.06 cts.
Net cost,	7.83 "
Manurial value obtainable,	6 23 "
Nutritive ratio,	1 : 7.81

4.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Hay,	15.00 "
Sugar beets,	27.00 "
Total cost,	25.12 cts.
Net cost,	17.10 "
Manurial value obtainable,	8.02 "
Nutritive ratio,	1 : 7.20

5.

Wheat bran,	3.25 lbs.
Hay,	15.00 "
Sugar beets,	27.00 "
Total cost,	21.41 cts.
Net cost,	14.31 "
Manurial value obtainable,	7.10 "
Nutritive ratio,	1 : 6.93

6.

Wheat bran,	3.25 lbs.
Hay,	15.00 "
Sugar beets,	40.00 "
Total cost,	24.66 cts.
Net cost,	16.66 "
Manurial value obtainable,	8.00 "
Nutritive ratio,	1 : 6.81

October, 1886, to April, 1887.

7.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	18.75 "
Total cost,	25.14 cts.
Net cost,	15.77 "
Manurial value obtainable,	9.37 "
Nutritive ratio,	1 : 6.11

8.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	5.00 "
Corn ensilage,	34.00 "
Total cost,	19 60 cts.
Net cost,	11.62 "
Manurial value obtainable,	7.98 "
Nutritive ratio,	1 : 6.12

9.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Gluten meal,	3.25 "
Hay,	10.00 "
Carrots,	38.00 "
Total cost,	31.89 cts.
Net cost,	23.05 "
Manurial value obtainable,	8.84 "
Nutritive ratio,	1 : 5.99

Principal Daily Fodder Rations used — *Concluded.*

January to May, 1888.

10.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 “
Gluten meal,	3.25 “
Fodder corn,	17.75 “
Total cost,	15.53 cts.
Net cost,	7.54 “
Manurial value obtainable,	7.99 “
Nutritive ratio,	1 : 5 82

11.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 “
Gluten meal,	3.25 “
Corn stover,	17.25 “
Total cost,	15.40 cts.
Net cost,	7.44 “
Manurial value obtainable,	7.96 “
Nutritive ratio,	1 : 5.98

12.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 “
Gluten meal,	3.25 “
Hay,	10.00 “
Corn ensilage,	21.75 “
Total cost,	21.64 cts.
Net cost,	13.15 “
Manurial value obtainable,	8.49 “
Nutritive ratio,	1 : 6.12

November, 1888, to May, 1889.

13.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 “
Gluten meal,	3.25 “
Hay,	10.00 “
Sugar beets,	47.25 “
Total cost,	30 40 cts.
Net cost,	20.22 “
Manurial value obtainable,	10.18 “
Nutritive ratio,	1 : 5.56

14.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 “
Gluten meal,	3.25 “
Rowen,	19.50 “
Total cost,	25.72 cts.
Net cost,	13.51 “
Manurial value obtainable,	12.21 “
Nutritive ratio,	1 : 5.06

Fodder rations Nos. 3, 8, 10, 11 and 14 deserve particular attention for trials. The remainder, although in some instances not without special interest, are published to illustrate our essential variations in the daily diet used.

TABULAR STATEMENT OF THE COST PER DAY OF THE ABOVE-MENTIONED FODDER COMBINATIONS.

	Total Cost.	Net Cost.	Manurial Value Obtainable.
	Cents.	Cents.	Cents.
No. 1,	23.43	15.43	8.00
" 2,	16.62	10 04	6.58
" 3,	14.06	7.83	6.23
" 4,	25.12	17.10	8.02
" 5,	21.41	14.31	7.10
" 6,	24.66	16.66	8.00
" 7,	25.14	15.77	9.37
" 8,	19.60	11.62	7.98
" 9,	31.89	23.05	8.84
" 10,	15.75	7.54	7.99
" 11,	15.40	7.44	7.96
" 12,	21.64	13 15	8.49
" 13,	30.40	20.22	10.18
" 14,	25.72	13.51	12.21

Considering the previously described fodder combinations from a mere financial stand-point, they rank, with reference to their net cost, beginning with the lowest, as follows: 11, 10, 3, 2, 8, 12, 14, 5, 1, 7, 6, 4, 13, 9. A close inquiry into the character of the coarser or bulky part of the various fodder compositions cannot fail to show that, wherever fodder corn, corn stover or corn ensilage have been fed in part or in the whole as a substitute for English hay, in connection with the same kind and amount of grain feed, the commercial value of the manurial refuse obtainable has been but slightly if any affected; while the net cost of the daily feed of the animals on trial has been materially reduced (from one-third to one-half). It seems scarcely necessary to mention, here, that only equally well-prepared fodder articles are considered in the discussion.

Sugar beets compare well, as far as net cost is concerned, with good corn ensilage, when fed in quantities of from twenty to twenty-five pounds of the former in place of from thirty to thirty-five pounds of the latter.

In view of these facts, it becomes a question of first importance to ascertain to what extent it will be judicious, as far as their commercial feed value is concerned, to advocate the substitution of dry fodder corn, corn stover and a good corn ensilage for English hay in the daily diet of dairy stock.

It is generally admitted that the present condition of the market for dairy products calls for the closest investigation of every point which bears on the cost of the production of milk; and it will be not less conceded, that next in importance to the selection of cows of good milking qualities comes the consideration of the cost of their daily diet.

Net Cost of Feed.

The actual cost of a daily diet for any kind of farm live stock does not alone depend on the temporary market cost of a given quantity of the various ingredients which constitute the daily fodder rations, but also in a controlling degree upon the quantity of some essential articles of plant food (in particular of nitrogen, phosphoric acid and potassium oxide) which they contain, and the amount of these which may be secured in some definite proportion in form of manurial refuse, after the fodder has served its purpose for the support of the life and the functions of the animal which consumes it. As has been already stated on previous occasions, the net cost of a daily diet is ascertained by deducting from the sum of the market price of its ingredients, the sum expressing the commercial value of their manurial constituents obtainable in each particular case. This circumstance deserves, for obvious reasons, the most serious consideration on the part of farmers, when choosing from among the various suitable fodder articles offered for their patronage, those for a daily diet of their farm live stock which will ultimately prove the cheapest in their position, in consequence of the higher commercial value of the manurial refuse they furnish.

It becomes the more important to select with that view in mind; as the fluctuations in the local market price of oil cakes, gluten meal, corn meal, wheat bran and of similar refuse materials (by-products) of flour mills, glucose works, starch works, breweries, etc., are, as a rule, liable to be more frequent and more serious than in case of home-raised coarse or bulky fodder articles, as English hay, corn stover, corn ensilage, etc. The commercial value of the manurial refuse obtainable from the first-named class, in case of corresponding weights and under similar circumstances, exceeds quite frequently from two to three times that obtainable in case of the latter.

Applying this standard of valuation to our feeding experiments, we notice the following relations : —

Fodder Articles used during our Feeding Experiments.

Name of Article.	Market Price per Ton.	Value of Manurial Constituents per Ton.	Relative Net Cost per Ton.
English hay, ...	$15 00	$5 58	$10 54
Rowen (dry), ...	15 00	9 83	7 14
Fodder corn (dry), . . .	5 00	4 53	1 38
Corn stover (dry), . . .	5 00	3 21	2 43
Corn ensilage, ...	2 75	1 56	1 50
Corn meal, ...	21 90	6 51	16 69
Wheat bran, ...	20 70	13 64	9 79
Gluten meal, ...	23 40	15 23	11 22

Considering our entire feeding experiments, 1885 to 1889, we find that corn meal has cost per ton $22.75, wheat bran $21, and gluten meal $24.50. The latter sells to-day at $23 per ton, corn meal at $19, and wheat bran at $16.50. The market price of hay, corn stover, etc., has practically remained the same, as far as the same season of the year is concerned. Serious variations in the market price of our fodder articles not infrequently advise changes from one article to another of a similar character and composition. At present local market prices of feed stuffs, hay and corn meal are very costly fodder articles; the same applies to carrots.

Feeding Value or Nutritive Value of Fodder Articles.

From preceding remarks it will be apparent that we have secured a satisfactory basis for our guidance to decide the relative money value of current fodder articles, as well as that of an entire diet. Quite different, however, is our situation, when the determination of their relative feeding value is involved; for it is an undeniable fact that the relative commercial value of fodder articles does not necessarily coincide with their relative feeding value; it rarely does. This circumstance arises from the fact that both are determined by different standards. The *commercial* or *money value* of *fodder articles*, as far as they enter the general market, is regulated like that of other articles of merchandise, by supply and demand; the greater the former and the less the latter, the lower is the market price, etc.; the relative money value of a given quantity can be expressed for the same locality by one definite sum.

The *feeding value* or *nutritive value* of a *fodder article* refers especially to its feeding effect; it depends usually on the co-operation of a series of varying conditions, sometimes more or less beyond our control. Foremost among these are: —

1. A higher degree of adaptation with reference to particular kind and organization of the animal under consideration; its age and functions, etc.

2. The chemical composition and the general physical conditions, depending on stage of growth, mechanical preparation, etc., of the fodder ingredients to be used.

3. Whether the article constitutes the sole diet, or serves as a more or less prominent part of the daily diet. The feeding effect of most fodder articles is more or less modified by, and thus in a controlling degree dependent on, the character of the associated ingredients in the daily diet.

These few remarks suffice to show that the comparative feeding value of one and the same fodder article, even when of a stable composition, cannot be fully expressed by one numerical value. The practice of stating the comparative feeding value of current fodder articles with reference to that of good English hay equal to 100, has been for years abandoned, as devoid of any substantial support. There is no single fodder article on record which furnishes the best diet — *i. e.*, the cheapest and at the same time most nutritive food — for even the same class of animals, under different circumstances. Both net cost of feed and its relative nutritive or feeding effect under existing circumstances, have to be consulted when aiming at an economical diet for farm live stock. Actual feeding experiments, under well-defined circumstances, alone can give us the desired information.

Although much needs still to be done in this direction to recognize in many instances more clearly the principles which underlie a successful practice, it must be admitted that some valuable facts have been already established in regard to a rational and thus economical system of stock feeding, by European investigators and others, which can serve advantageously as guides in compounding economical fodder combinations for all kinds of farm live stock. The economy of milk production, in particular, has received much attention. European investigators recommend in this connection quite generally a daily diet, rich in digestible nitrogenous constituents, as beneficial to the general condition of cows, and at the same time reducing the net cost of the feed consumed, by furnishing larger quantities of valuable home-made manure at the lowest market cost. The European standard for a daily diet of milch cows calls for one part of digestible nitrogenous fodder constituents to five and four-tenths parts of digestible non-nitrogenous food constituents. Our results, on the whole, point in the same direction. The nitrogenous food constituents of the fodder rations received special attention.

The main interest of our inquiry, however, consists in the partial or entire successful substitution, under otherwise corresponding circumstances, of dry fodder corn or corn stover or corn ensilage for English hay, as far as net cost of feed and quality and quantity of milk are concerned. The results of former years of observation are already on record in our respective annual reports; they lead to the same conclusions as those stated in the introduction to our latest experiment, described in preceding pages. The net cost of the daily feed during our late experiment has been reported in that connection. The quality of the milk and cream obtained on that occasion may be learned from the subsequent tabular creamery records of the station. (See "Feeding Experiment," chapter IV., creamery record of the Massachusetts State Agricultural Experiment Station during the years 1885 to 1889, contained in this report.)

II. FEEDING EXPERIMENTS WITH MILCH COWS; GREEN CROPS *vs.* ENGLISH HAY. JUNE 19 TO OCT. 22, 1889.

The first experiment in this direction was instituted in 1887, for the purpose of comparing the feeding effects of good English hay with that of some reputed green fodders. The green crops selected for our observation consisted of a mixed crop of oats and vetch, of Southern cow-pea and of serradella.

1887. — Five cows were engaged in the trial. Two cows were fed with a daily fodder ration consisting of corn meal, 3¼ pounds (2 quarts); wheat bran, 3¼ pounds (4 quarts); English hay, 20 to 24 pounds. The excess of hay left over was weighed back and subsequently deducted from the original quantity (about ⅓ to ½ pound per day).

Three cows received periodically the above-stated daily rations, and alternately the following: corn meal, 3¼ pounds; wheat bran, 3¼ pounds; English hay, 5 pounds; and as much of either green vetch and oats, green Southern cow-pea or green serradella, as the individual animal would consume. They consumed per day, on an average, from 64 to 65 pounds of green vetch and oats; of green Southern cow-pea, 96 to 97 pounds; and in case of green serradella, from 97 to 98 pounds. The feeding of the green crop commenced in every instance with the beginning of the blooming period. The rate of consumption of green crops decreased gradually with the progress of their growth.

The feeding of the different green fodders, in place of three-fourths of the customary daily rations of English hay, gave, on the whole, very satisfactory results. For details, we have to refer to the fifth annual report of the station.

1888. — The experiment was repeated with some modifications. A mixed crop of vetch and oats, of Southern cow-pea and of serradella, was raised for that purpose. The latter crop suffered seriously from blight, and was not fit for feeding.

The quantity of green fodder fed at stated times was somewhat less in pounds than in the trial during the preceding year, on account of the addition of gluten meal to the fodder ration of that year. The daily diet (1888) consisted of corn meal, 3¼ pounds; wheat bran, 3¼ pounds; gluten meal, 3¼ pounds; English hay, 5 pounds; and as much vetch and oats or cow-pea as the animal would consume, which amounted, in the case of green vetch and oats, to from 54 to 68 pounds; and in that of green Southern cow-pea, from 70 to 80 pounds. One-fourth (five pounds) of the ordinary daily hay ration was retained in our green fodder diet, for the purpose of preventing disorders in the digestion of a liberal quantity of green fodder.

The nutritive ratio of the green fodder diet was a closer one than on former occasions, varying from 1 : 4.5 to 1 : 5.5. The nutritive effect was very satisfactory, for the animals, without exception, maintained their original weight; the yield of milk was in every instance somewhat raised, and the quality of the milk was equal to the best, as far as one and the same animal was concerned. The net cost of the feed for the production of one quart of milk was in most instances lower than in case of a whole English hay ration.

The cost of green fodder is based on that of hay, $15 per ton; allowing two tons of hay, with fifteen per cent. of moisture, as the average produce of English hay per acre. This mode of valuation has been adopted, as on previous occasions, on account of the entire absence of market prices, as far as green vetch, cow-pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Valuation per Ton of the Fodder Articles. (1888.)

Corn meal, . . .	$24 00	Vetch and oats (green), .	$2 75
Corn and cob meal, . .	20 70	Cow-pea (green), . .	3 14
Wheat bran, . . .	22 50	Serradella (green), . .	3 16
Gluten meal, . . .	22 50	Rowen, ...	15 00
English hay, . . .	15 00		

1889. — Six cows at a time served in the trial; the observation began in June and closed in October, 1889. The course adopted during the preceding year was adhered to in every essential point. The daily diet consisted of 3¼ pounds each of corn meal, wheat bran and gluten meal, with 5 pounds of hay, and all the green vetch and oats, green cow-pea or green serradella called for by each individual cow. The amount actually consumed per day varied in case of vetch and oats from 30 to 55 pounds; of cow-pea, from 66 to 84 pounds; and, in case of serradella, from 63 to 85 pounds; showing but little preference for one as compared with the others. The difference in the daily consumption of the green fodders was due largely to their variations in dry vegetable matter during the progress of the experiment. The experiment was sub-divided into five feeding periods, beginning and ending with a hay fodder ration. The daily waste of coarse feed amounted per head to four pounds in case of oats and vetch, to two pounds in case of serradella, to one and one-half pounds in case of cow-pea; and, in case of hay, to one-half pound.

The results obtained fully sustain the conclusions presented in our previous reports, namely: —

1. The weight of dry vegetable matter contained in the feed consumed for the production of one quart of milk is less in case of the green fodder rations than in the hay ration; indicating a superior nutritive value of the former, as compared with the latter.

2. The yield of milk is in every instance increased, when changing from a hay ration to a green fodder ration.

3. The quality of milk is but slightly altered in case of different cows; the solids in some instances are slightly increased, in others they are slightly decreased. The creamery record, as will be seen from subsequent abstracts, is very satisfactory in case of the green fodder rations.

4. The net cost of feed for the production of milk is in every instance less in case of green fodder rations than in the hay ration.

5. The weight of the animal has in most instances increased towards the close of the experiment.

Valuation of Fodder Articles for the Months of June to October of the Year 1889.

	Per Ton.		Per Ton.
Corn meal,	$19 00	Cow-pea,	$3 14
Wheat bran,	18 50	Serradella,	3 16
Gluten meal,	22 00	Hay,	15 00
Vetch and oats,	2 75		

FEEDING RECORD.

JESSIE: *Age, five years; grade, Jersey; last calf, Jan. 12, 1889.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27,	3.25	3.25	3.25	18.70	–	–	–	25.56	10.90	2.34	1 : 6.23	819
July 2 to July 15,	3.25	3.25	3.25	3.64	55.43	–	–	23.89	10.59	2.26	1 : 6.52	833
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	84.30	–	27.43	11.74	2.34	1 : 6.12	823
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	85.77	27.18	11.00	2.47	1 : 4.68	805
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19.74	–	–	–	26.50	9.51	2.79	1 : 6.29	855

FLORA: *Age, five years; grade, Durham; last calf, Dec. 22, 1888.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
June 19 to June 24,	3.25	3.25	3.25	18.80	–	–	–	25.65	11.71	2.19	1 : 6.24	940
July 2 to July 15,	3.25	3.25	3.25	5.00	30.14	–	–	19.71	10.01	1.97	1 : 6.01	904
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	80.90	–	26.85	13.51	1.99	1 : 6.07	932
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	79.54	26.16	11.72	2.23	1 : 4.70	930
Oct. 4 to Oct. 22,	3.25	3.25	3.25	17.79	–	–	–	24.74	10.69	2.31	1 : 6.17	974

FEEDING RECORD — *Continued.*

EVA: *Age, nine years; grade, Jersey; last calf, Oct. 7, 1888.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27, ...	3.25	3.25	3.25	17.20	–	–	–	24.20	10.04	2 41	1 : 6.13	1,044
July 2 to July 15, ...	3.25	3.25	3.25	5.00	41.79	–	–	22.24	9.88	2.25	1 : 6.30	1,039
Sept. 1 to Sept. 10, ...	3.25	3.25	3.25	5.00	–	83.50	–	27.30	11.41	2.39	1 : 6.11	1,015
Sept. 15 to Sept. 27, ...	3.25	3.25	3.25	5.00	–	–	82.46	26.64	9.13	2.92	1 : 4.69	1,039
Oct. 4 to Oct. 22, ...	3.25	3.25	3.25	19 26	–	–	–	26.07	8.21	3.18	1 : 6.26	1,078
ANNIE: *Age, six years; grade, Jersey; last calf. June 19, 1888.*												
June 19 to June 27, ...	3.25	3.25	3.25	16.00	–	–	–	23.12	10.03	2.31	1 : 6.06	909
Sept. 1 to Sept. 10, ...	3.25	3.25	3.25	5.00	–	66.30	–	24.38	10.64	2.29	1 : 5.97	903
Sept. 15 to Sept 27, ...	3.25	3.25	3.25	5 00	–	–	63.15	23.48	9.04	2.60	1 : 4.74	898
Oct. 4 to Oct. 22, ...	3.25	3.25	3.25	17.32	–	–	–	24.31	8.39	2.90	1 : 6.14	936

FEEDING RECORD — *Concluded.*

Elsie: *Age, six years; grade, Holstein; last calf, Feb. 26, 1889.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (in Pounds).	Quarts of Milk produced per day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.					
1889.												
June 19 to June 27,	3.25	3.25	3.25	20.00	–	–	–	26.74	10.58	2.53	1 : 6.31	1,148
July 2 to July 15,	3.25	3.25	3.25	5.00	55.29	–	–	25.18	10.25	2.46	1 : 6.60	1,145
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	69.60	–	24.94	9.93	2.51	1 : 5.99	1,132
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	77.08	25.76	9.22	2.79	1 : 4.70	1,141
Oct. 4 to Oct. 22,	3.25	3.25	3.25	19.95	–	–	–	26.69	8.51	3.14	1 : 6.31	1,188
Juno: *Age, six years; grade, Ayrshire; last calf, June 22, 1889.*												
July 2 to July 15,	3.25	3.25	3.25	5.00	49.36	–	–	23.89	14.74	1.62	1 : 6.47	975
Sept. 1 to Sept. 10,	3.25	3.25	3.25	5.00	–	72.80	–	25.48	14.74	1.73	1 : 6.02	1,014
Sept. 15 to Sept. 27,	3.25	3.25	3.25	5.00	–	–	81.38	26.46	12.93	2.05	1 : 4.69	984
Oct. 4 to Oct. 22,	3.25	3.25	3.25	21.74	–	–	–	28.31	12.15	2.33	1 : 6.40	1,040

TOTAL COST OF FEED PER QUART OF MILK.

Annie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27, ...	90.25	10.03	29.25	29.25	29.25	144.00	–	–	–	$1 95	2.16
Sept. 1 to Sept. 10, ...	106 38	10.64	32.50	32 50	32.50	50.00	–	663.00	–	2 38	2.24
Sept. 15 to Sept. 27, ...	117.50	9.04	42.25	42.25	42.25	65.00	–	–	821 00	3 04	2.59
Oct. 4 to Oct. 22, ...	159.38	8.39	61.75	61.75	61.75	329.00	–	–	–	4 30	2.70
Elsie.											
June 19 to June 27, ...	95.25	10.58	29.25	29.25	29.25	180.00	–	–	–	$2 22	2.33
July 2 to July 15, ...	143.50	10.25	45.50	45.50	45.50	70.00	774.00	–	–	2 94	2.05
Sept. 1 to Sept. 10, ...	99.25	9.93	32.50	32.50	32.50	50.00	–	696.00	–	2 43	2.45
Sept. 15 to Sept. 27, ...	119.88	9.22	42.25	42.25	42.25	65.00	–	–	1,002.00	3 33	2.78
Oct. 4 to Oct. 22, ...	161.63	8.51	61.75	61.75	61.75	379.00	–	–	–	4 68	2.89
Juno.											
July 2 to July 15, ...	206.38	14.74	45.50	45.50	45.50	70.00	691.00	–	–	$2 83	1.37
Sept. 1 to Sept. 10, ...	147.38	14.74	32.50	32.50	32 50	50 00	–	728.00	–	2 49	1.69
Sept. 15 to Sept. 27, ...	168.13	12.93	42.25	42.25	42.25	65.00	–	–	1,058.00	3 42	2.03
Oct. 4 to Oct. 22, ...	230.88	12.15	61.75	61.75	61.75	413.00	–	–	–	4 93	2.14

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

Jessie.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27,	98 13	10.90	29.25	29.55	29.25	168.00	–	–	–	$2 13	2.17
July 2 to July 15,	148 25	10.59	45.50	45.50	45.50	51.00	776.00	–	–	2 81	1.89
Sept. 1 to Sept. 10,	117.38	11.74	32.50	32.50	32.50	50.00	–	843.00	–	2 67	2.27
Sept. 15 to Sept. 27,	143 00	11.00	42.25	42.25	42.25	65.00	–	–	1,115.00	3 51	2.45
Oct. 4 to Oct. 22,	180.75	9.51	61.75	61.75	61.75	375.00	–	–	–	4 64	2.56

Flora.

FEEDING PERIODS.	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serradella consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
June 19 to June 24,	70.25	11.71	19.50	19.50	19.50	113.00	–	–	–	$1 43	2.04
July 2 to July 15,	140.13	10.01	45.50	45.50	45.50	70.00	422.00	–	–	2 46	1.76
Sept. 1 to Sept. 10,	135.13	13.51	32.50	32 50	32.50	50.00	–	809.00	–	2 61	1.93
Sept. 15 to Sept. 27,	152.38	11.72	42.25	42.25	42.25	65.00	–	–	1,034 00	3 38	2.22
Oct. 4 to Oct. 22,	203.13	10.69	61.75	61.75	61.75	338.00	–	–	–	4 37	2.15

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Eva.

FEEDING PERIODS	Total Quantity of Milk produced.	Average Daily Yield of Milk.	Total Amount of Corn Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Hay consumed.	Total Amount of Vetch and Oats consumed.	Total Amount of Cow-pea consumed.	Total Amount of Serra-della consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk.
1889.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
June 19 to June 27, ...	90.38	10.04	29.25	29.25	29.25	155.00	–	–	–	$2 03	2.25
July 2 to July 15, ...	137.38	9.88	45.50	45.50	45.50	70.00	685.00	–	–	2 82	2.06
Sept. 1 to Sept. 10, ...	114.13	11.41	32.50	32.50	32.50	50.00	–	835.00	–	2 65	2.32
Sept. 15 to Sept. 27, ...	118.75	9.13	42.25	42.25	42.25	65.00	–	–	1,072.00	3 44	2.90
Oct. 4 to Oct. 22, ...	156.00	8.21	61.75	61.75	61.75	366.00	–	–	–	4 58	2.94

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents. (1889.)

[Per cent.]

	Corn Meal.	Wheat Bran.	Gluten Meal.	Hay.	Vetch and Oats.	Cow-pea.	Serradella.
Moisture, ...	13.290	10.92	10.19	9.48	78.26	83.07	83.65
Nitrogen, ...	1.564	2.447	4.230	1.463	.268	.304	.470
Phosphoric acid, . .	.720	2.900	.392	.303	.112	.098	.112
Potassium oxide, . .	.434	1.637	.049	1.350	.324	.172	.178
Valuation per 2,000 lbs.,	$6 57	$13 27	$14 90	$6 55	$1 34	$1 31	$1 89

Net Cost of Milk and Manurial Value of Feed.

Jessie.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Lbs.
June 19 to June 27, .	$2 13	$0 98	$0 78	$1 35	1.38	838
July 2 to July 15, .	2 81	1 48	1 18	1 63	1.10	840
Sept. 1 to Sept. 10, .	2 67	1 28	1 02	1 65	1.41	810
Sept. 15 to Sept. 27, .	3 51	2 00	1 60	1 91	1.34	820
Oct. 4 to Oct. 22, .	4 64	2 30	1 84	2 80	1.55	888
Total, . .	$15 76	$8 04	$6 42	$9 34	–	–

Flora.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
June 19 to June 24, .	$1 43	$0 71	$0 57	$0 86	1.22	952
July 2 to July 15, .	2 46	1 30	1 04	1 42	1.01	905
Sept. 1 to Sept. 10, .	2 61	1 26	1 01	1 60	1.18	938
Sept. 15 to Sept. 27, .	3 38	1 92	1 54	1 84	1.21	933
Oct. 4 to Oct. 22, .	4 37	2 18	1 74	2 63	1.29	1,000
Total, . .	$14 25	$7 37	$5 90	$8 35	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Eva.

FEEDING PERIODS.	Total Cost of Feed consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of Feed after deducting the Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Lbs.
June 19 to June 24, .	$2 03	$0 94	$0 75	$1 28	1.42	1,046
July 2 to July 15, .	2 82	1 48	1 18	1 64	1.19	1,030
Sept. 1 to Sept. 10, .	2 65	1 27	1 02	1 63	1.43	1,030
Sept. 15 to Sept. 27, .	3 44	1 96	1 57	1 87	1.58	1,038
Oct. 4 to Oct. 22, .	4 58	2 27	1 82	2 76	1.77	1,109
Total, . .	$15 52	$7 92	$6 34	$9 18	–	–

Annie.

June 19 to June 27, .	$1 95	$0 91	$0 73	$1 22	1.35	915
Sept. 1 to Sept. 10, .	2 38	1 16	93	1 45	1.36	888
Sept. 15 to Sept. 27, .	3 04	1 72	1 38	1 66	1.41	896
Oct. 4 to Oct. 22, .	4 30	2 15	1 72	2 58	1.62	976
Total, . .	$11 67	$5 94	$4 76	$6 91	–	–

Elsie.

June 19 to June 27, .	$2 22	$1 01	$0 81	$1 41	1.48	1,150
July 2 to July 15, .	2 94	1 54	1 23	1 71	1.19	1,142
Sept. 1 to Sept. 10, .	2 43	1 18	94	1 49	1.50	1,134
Sept. 15 to Sept. 27, .	3 33	1 89	1 51	1 82	1.52	1,148
Oct. 4 to Oct. 22, .	4 68	2 31	1 85	2 83	1.75	1,210
Total, . .	$15 60	$7 93	$6 34	$9 26	–	–

Juno.

July 2 to July 15, .	$2 83	$1 48	$1 18	$1 65	.80	990
Sept. 1 to Sept. 10, .	2 49	1 20	96	1 53	1.04	1,010
Sept. 15 to Sept. 27, .	3 42	1 95	1 56	1 86	1.11	978
Oct. 4 to Oct. 22, .	4 93	2 42	1 94	2 99	1.29	1,046
Total, . .	$13 67	$7 05	$5 64	$8 03	–	–

ANALYSES OF MILK.

[Per cent.]

Jessie.

1889.	June 25.	July 16.	Sept. 12.	Sept. 24.	Oct. 15.
Solids, ...	14.76	15.03	13.90	15.43	14.74
Fat, ...	5.36	5.32	4.74	5.56	5.33
Solids not fat, . . .	9.41	9.71	9.16	9.87	9.41

Flora.

Solids, ...	15.56	13.33	12.46	14.11	13.35
Fat, ...	4.78	3.76	3.33	4.36	4.10
Solids not fat, . . .	10.78	9.57	9.13	9.75	9 25

Eva.

Solids, ...	14.79	15.06	14.07	16.25	16.25
Fat, ...	4.89	5.13	4.65	6.00	6.10
Solids not fat, . . .	9.90	9.93	9.42	10.25	10.15

Annie.

Solids, ...	14.18	14.20	14.12	15.71	15.68
Fat, ...	4.39	4.65	4.55	5.12	5.18
Solids not fat, . . .	9.79	9.55	9.57	10.59	10.50

Elsie.

Solids, ...	12.70	13.05	12.29	13.33	12.82
Fat, ...	3.45	3.52	3.42	5.17	3.55
Solids not fat, . . .	9.25	9.53	8.87	8.16	9.27

Juno.

Solids, ...	–	12.53	11.35	12.87	13.22
Fat, ...	–	2.93	2.78	4.11	4.03
Solids not fat, . . .	–	9.60	8.57	8.76	9.19

COMPOSITION OF FODDER ARTICLES FED DURING THIS EXPERIMENT.

Corn Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.29	265.80	–	–	1 : 9.09
Dry matter, . . .	86.71	1,734.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.67	33.40	–	–	
" cellulose, . . .	1.69	33.80	11.49	34	
" fat, ...	4.04	80.80	61.41	76	
" protein (nitrogenous matter), . .	11.00	220.00	187.00	85	
Non-nitrogenous extract matter, ...	81.60	1,632.00	1,534.08	94	
	100.00	2,000.00	1,793.98	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.92	218.40	–	–	1 : 3.99
Dry matter, . . .	89.08	1,781.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.00	140.00	–	–	
" cellulose, . . .	11.52	230.40	46.08	20	
" fat, ...	5.43	108.60	86.88	80	
" protein (nitrogenous matter), . .	17.17	343.40	302.19	88	
Non-nitrogenous extract matter, ...	58.88	1,177.60	942.08	80	
	100.00	2,000.00	1,377.23	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.19	203.80	–	–	1 : 2.86
Dry matter, . . .	89.81	1,796.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.57	11.40	–	–	
" cellulose, . . .	.56	11.20	3.81	34	
" fat, ...	6.40	128.00	97.28	76	
" protein (nitrogenous matter), . .	29.45	589.00	500.65	85	
Non-nitrogenous extract matter, ...	63.02	1,260.40	1,184.78	94	
	100.00	2,000.00	1,786.52	–	

Hay (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.48	189.60	–	–	1 : 8.99
Dry matter, . . .	90.50	1,810.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.12	142.40	–	–	
" cellulose, . . .	33.22	664.40	385.35	58	
" fat, ...	2.30	46.00	21.16	46	
" protein (nitrogenous matter), . .	10.09	201.80	115.03	57	
Non-nitrogenous extract matter, ...	47.27	945.40	595.60	63	
	100.00	2,000.00	1,117.14	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

Vetch and Oats.*

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	78.26	1,565.20	–	–	1 : 11.26
Dry matter,	21.74	434.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	4.53	90.60	–	–	
" cellulose,	36.22	724.40	–	–	
" fat,	2.53	50.60	25.30	50	
" protein (nitrogenous matter),	7.72	154.40	92.64	60	
Non-nitrogenous extract matter,	49.00	980.00	980.00	100	
	100.00	2,000.00	1,097.94	–	

Cow-pea.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.07	1,661.40	–	–	1 : 7.46
Dry matter,	16.93	338.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.35	147.00	–	–	
" cellulose,	21.87	437.40	205.58	47	
" fat,	2.99	59.80	35.28	59	
" protein (nitrogenous matter),	11.24	224.80	134.88	60	
Non-nitrogenous extract matter,	56.55	1,131.00	712.53	69	
	100.00	2,000.00	1,088.27	–	

COMPOSITION OF FODDER ARTICLES, ETC. — *Concluded.*

Serradella.

[Experiment Station, 1889.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	83.65	1,673 00	–	–	1 : 4.27
Dry matter,	16.35	327.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8.94	178.80	–	–	
" cellulose,	25.92	518.40	–	–	
" fat,	2.38	47.60	28.56	60	
" protein (nitrogenous matter),	17.97	359.40	226.42	63	
Non-nitrogenous extract matter,	44.79	895.80	895.80	100	
	100.00	2,000.00	1,150.78	–	

Vetch and Oats. (1889.)

[Left uneaten by the cows during experiment.]

	Per Cent.
Moisture at 100° C.,	4.94
Dry matter,	95.06
	100.00
Analysis of Dry Matter.	
Crude ash,	4.61
" cellulose,	36.72
" fat,	1.79
" protein (nitrogenous matter),	10.52
Non-nitrogenous extract matter,	46.36
	100.00

III. RECORD OF TWELVE COWS WHICH SERVED AT THE STATION FOR EXPERIMENTS TO ASCERTAIN THE COST OF FEED FOR THE PRODUCTION OF MILK.

When entering at this station upon the task of ascertaining the cost of feed for the production of milk (1884), it was decided to begin the inquiry with cows of moderate milking qualities. Grades of all kinds of breeds were to serve for that purpose. A selection from that class of cows, at the outset of our observation, promised to prove of a special interest, not only on account of their large representation in our dairy stock, but also for the particular chance which our final results would offer to draw more directly the line where milk production ceases to be a profitable business. The material for the subsequent report has been carefully collected during a period of several years. The results, it is true, are obtained under somewhat exceptional circumstances; yet their detailed description cannot fail to show more clearly the financial relation of milk production to a system of a mixed farm management.

The cows which served in our trials were in every instance secured a few days after calving. They were sold to the butcher usually when their daily yield of milk fell below from five to six quarts, to make room for a new-milch cow. The cost of the different animals varied from fifty-five to seventy-two dollars each; they sold at the close of their trial for from twenty-five to thirty-seven dollars each.

The management of the entire experiment was conducted with a view to promote the general health of the animals on trial. Two cows had lost in weight during the experiment, and ten had gained more or less. The change from one diet to another was as a rule a gradual one.

The temporary change in the composition of the daily diet was mainly confined to the coarser and bulky fodder ingredients. English hay, dry fodder corn, corn stover, corn ensilage and roots, besides some small quantity of various dried fodder crops, incidental to some field experiments with forage crops, were fed during the latter part of autumn, the winter and the spring; while several green crops, as oats or barley and vetch, serradella and cow-peas, were substituted during the summer and part of the fall season. The several previously named fodder crops served in the majority of cases either in part or in the whole as substitutes for English hay.

The daily rations of grain fed consisted throughout the entire period, in all cases alike, substantially of the same materials; namely, corn meal or corn and cob meal, and wheat bran, which were supplemented, in the majority of instances, more or less by gluten meal, to secure as far as practicable the desired comparative nutritive character of the diet. The daily diet per head consisted of from eighteen to twenty or more pounds of hay, or its equivalent in part or in the whole of dry vegetable matter of the above-mentioned bulky fodder articles, and from six and one-half to nine and three-quarters pounds of grain feed, usually composed of corn meal or corn and cob meal, and wheat bran, with or without gluten meal (three and one-fourth pounds).

The ruling local average market price of each fodder article has been used for the determination of the cost of feed consumed. The estimates of fertilizing constituents contained in the various fodder articles used are based on our own analysis, and on their local market price during the past year. Twenty per cent. loss of the fertilizing constituents contained in the feed has been allowed for the amount sold with the milk.

The period of observation varied, in case of different cows, from 261 to 747 days; the average daily yield of milk per head for the whole period of observation varied from 7.7 to 12.4 quarts.

Three cents per quart of milk produced has been adopted as the average price realized for the entire year, in case of milk contracts in our vicinity.

The essential details of our observations are subsequently recorded in tabular form, under the following headings: —

1. History of cows.
2. Statement of the amount of each kind of fodder ingredients consumed by each animal, with total cost of feed for period of observation.
3. Local market value per ton of each fodder article used.
4. Value of essential fertilizing constituents contained in the various articles of fodder consumed.
5. Summary of financial record of cows.
6. Some conclusions suggested by the financial record.

1. *History of Cows on Trial.*

NAME AND AGE OF COW.		Breed (Grades).	Number of Calves.	Last Calf.	Date of Arrival.	Date of Departure.	Number of Days milked.	Total Yield of Milk during Observation (Quarts).	Average Yield of Milk per Day at Beginning of Observation (Quarts).	Average Yield of Milk per Day during Ninth Month (Quarts).	Average Yield of Milk per Day at Close of Observation (Quarts).	Average Yield of Milk per Day during Entire Observation (Quarts).	Total Yield of Milk for First 300 Days of Observation (Quarts).	Average Yield of Milk per Day for First 300 Days of Observation (Quarts).	Live Weight of Animal at Beginning of Observation (Pounds).	Live Weight of Animal at Close of Observation (Pounds).
1. Bessie,	8 yrs.,	Jersey, .	4	Oct. 17, 1884,	Oct. 23, 1884,	Oct. 31, 1885,	374	3,724.3	16.5	9.2	6.9	10.0	3,213.3	10.7	809	833
2. Lady Horace,	8 yrs.,	Ayrshire,	4	Oct. 15, 1884,	Oct. 23, 1884,	Oct. 31, 1885,	374	4,063.5	16.7	9.8	7.9	10.9	3,486.3	11.6	931	970
3. Daisy (1),	7 yrs.,	Ayrshire,	3	Nov. 10, 1885,	Nov. 17, 1885,	Sept. 16, 1886,	304	3,613.5	15.3	7.9	10.5	11.9	3,571.5	11.9	911	838
4. Mollie,	7 yrs.,	Ayrshire,	3	Nov. 6, 1885,	Nov. 17, 1885,	Sept. 19, 1886,	307	3,124.6	12.1	8.1	8.5	10.2	3,063.5	10.2	891	880
5. Susie,	5 yrs.,	Ayrshire,	2	July 14, 1886,	July 30, 1886,	May 3, 1887,	278	3,446.5	15.5	9.8	9.8	12.4	3,653 3*	12.2	849	1,025
6. Meg,	6 yrs.,	Devon, .	3	Aug. 2, 1886,	Aug. 16, 1886,	May 3, 1887,	261	3,233.8	17.2	10.8	10.9	12.4	3,623.8*	12.1	1,018	1,152
7. Lizzie,	5 yrs.,	Native, .	2	Feb. 1, 1887,	Feb. 5, 1887,	June 22, 1888,	503	6,023.3	19.7	9.2	8.3	12.0	4,176.8	13.9	995	1,102
8. Ida,	7 yrs.,	Durham,	4	Feb. 3, 1887,	Feb. 7, 1887,	Jan. 3, 1987,	331	2,527.8	16.0	3.9	1.3	7.7	2,496.0	8.3	978	1,000
9. Minnie,	7 yrs.,	Ayrshire,	4	May 3, 1887,	May 17, 1887,	Dec. 22, 1888,	584	6,779 0	17.5	12.8	5.1	11.6	3,996.3	13.3	885	1,011
10. Daisy (2),	5 yrs.,	Durham,	3	Jan. 5, 1888,	Jan. 16, 1888,	Jan. 19, 1889,	369	4,557.8	18.9	10.2	6.3	12.4	4,106.5	13.7	1,132	1,185
11. May,	8 yrs.,	Jersey, .	3	June 6, 1887,	June 13, 1887,	June 28, 1889,	747	7,843.5	14.3	12.0	9.6	10.5	3,419.0	11.4	817	990
12. Melia,	10 yrs.,	Dutch, .	7	Aug. 5, 1887,	Aug. 11, 1887,	Mar. 1, 1889,	569	6,366 6	14.3	11.8	7.1	11.2	3,866 5	12.9	964	1,115
Averages,	. .	. . .		. . .	. . .	. . .	417	4,608.7	16.2	9.6	7 7	11.1	3,556.1	11.9	932	1,008

* Estimated.

2. *Amount of Each of the Various Kinds of Feed consumed (in Pounds) by the Cows on Trial.*

	1. Bessie.	2. Lady Horace.	3. Daisy (1).	4. Mollie.	5. Susie.	6. Meg.	7. Lizzie.	8. Ida.	9. Minnie.	10. Daisy (2).	11. May.	12. Melia.
Corn meal,	941.25	941.25	877.50	890.50	900.25	848.50	1,126.50	1,075.75	1,343.50	642.25	1,846.00	1,292.00
Corn and cob meal,	–	–	–	–	–	–	508.25	–	557.25	557.25	557.25	557 25
Wheat bran,	931 25	931.25	939.25	955.50	825.50	776.75	1,530.75	975.00	1,868.75	1,199.25	2,403.25	1,849 25
Rye middlings,	–	–	–	–	74 75	71 50	156 00	156 00	65.00	–	–	–
Gluten meal,	74.75	74.75	–	–	520.00	523.25	771.50	304.00	1,083.00	1,134 50	1,685.25	1,312.50
Hay,	4,228.75	5,122.00	2,962.00	2,780 00	4,073.50	3,311.50	7,418.75	4,925.25	6,886.00	4,354.50	8,086.50	6,656.50
Rowen,	–	–	–	–	–	500.00	1,833.25	1,268.00	1,836.00	528 00	2,464.00	1,843.00
Corn fodder (dry),	324.75	408.00	435.00	473.00	399 50	313.00	713.25	–	824 50	1,600.00	1,059.00	925 00
Corn stover (dry),	–	–	–	–	94.00	90.50	112.00	90.50	86.25	368.00	304 00	242.00
Corn ensilage,	2,098.00	2,188 00	2,990 00	2,959.00	930 00	826.50	878.00	–	1,017 25	1,539.25	2,415.00	2,150.00
Millet (dry),	156 00	119 00	37.00	32.00	–	–	–	–	–	–	–	–
Vetch and lucerne (dry),	72.00	98 00	–	–	–	–	–	–	–	–	–	–
Lucerne and clover (dry),	24.00	30.00	–	–	–	–	–	–	–	–	–	–
Oats (dry),	–	–	308.00	528.00	–	–	–	–	–	–	–	–
Oats (green),	–	–	585.00	585.00	70.00	140.00	–	–	–	–	–	–
Vetch and oats (green),	–	–	–	–	–	–	–	–	2,059.50	1,051.00	2,206.00	998 00
Vetch (green),	–	–	319.00	251.00	40.00	45 00	–	–	–	–	–	–
Serradella (green),	–	–	580.00	725.00	320.00	–	–	–	2,408.50	–	2,374.00	–
Cow-pea (green),	–	–	656.00	676.00	700.00	711.00	–	–	3,109.00	821.00	3,110.00	783.00
Barley and beans (green),	215.00	245.00	–	–	–	–	–	–	–	–	–	–
Potatoes,	–	–	–	–	–	–	–	1,190 00	–	–	–	–
Carrots,	–	–	–	–	–	–	–	–	–	859.00	916.00	918.00
Roots (sugar beets),	–	–	1,592.00	1,592.00	1,041.50	1,052.00	519.50	567.50	91.00	92.00	92.00	92.00
Total cost of feed,	$59 00	$65 65	$56 46	$56 04	$63 25	$59 50	$118 96	$80 08	$135 05	$88 33	$174 60	$130 51

3. *Local Market Value per Ton of the Various Articles of Fodder used.*

Corn meal,	$23 00
Corn and cob meal,	20 70
Wheat bran,	21 50
Rye middlings,	21 50
Gluten meal,	23 00

Hay,	$15 00	Vetch and oats (green),	$2 75
Rowen,	15 00	Vetch (green),	3 50
Corn fodder,	5 00	Serradella (green),	3 16
Corn stover,	5 00	Cow-pea (green),	3 14
Corn ensilage,	2 25	Barley and horse bean (green),	3 00
Millet (dry),	12 00	Potatoes,	6 67
Lucerne and vetch (dry),	12 00	Carrots,	7 00
Lucerne and clover (dry),	12 00	Sugar beets,	5 00
Oats (dry),	12 00		
Oats (green),	3 60		

4. *Valuation of the Essential Fertilizing Constituents contained in the Various Articles of Fodder used.*

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

[Per cent.]

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Corn meal,	1.86	0.77	0.45	$7 44
Corn and cob meal,	1.46	0.603	0.441	5 91
Wheat bran,	2.82	3.05	1.49	14 24
Rye middlings,	1.84	1.26	0.81	8 27
Gluten meal,	5.22	0.40	0.05	17 75
Hay,	1.25	0.464	2.085	6 46
Rowen,	1.93	0.364	2.86	9 24
Corn fodder (dry),	1.37	0.368	0.355	5 26
Corn stover (dry),	0.78	0.09	0.599	3 19
Corn ensilage,	0.36	0.14	0.33	1 64
Millet (dry),	1.106	0.38	2.49	6 23
Lucerne and vetch (dry),	2.02	0.70	2.273	9 44
Lucerne and clover (dry),	2.06	0.623	1.805	9 08
Oats (dry),	1.47	0.51	2.41	7 51
Oats (green),	0.33	0.155	0.68	1 85
Vetch and oats (green),	0.23	0.09	0.79	1 54
Vetch (green),	0.49	0.20	0.66	2 42
Serradella (green),	0.411	0.14	0.423	1 89
Cow-pea (green),	0.561	0.098	0.306	2 23
Barley and beans (green),	0.50	0.20	0.40	2 23
Potatoes,	0.476	0.18	0.56	2 18
Carrots,	0.14	0.10	0.54	1 04
Sugar beets,	0.29	0.03	0.18	1 15

5. *Summary of Financial Record of Cows.*

NAME OF COW.	Total Value of Milk at Three Cents per Quart.	Total Cost of Feed consumed.	Manurial Value of Food, less Twenty Per Cent. taken by Milk.	Net Cost of Feed.	Original Cost of Cow.	Selling Price of Cow.	Total Value received above Net Cost of Feed and of Cow.	Value received in Form of Manure.	Value received in Form of Cash.	Total Value received per Day.
										Cents.
1. Bessie, ...	$111 73	$59 00	$22 27	$36 73	$65 00	$25 00	$35 00	$22 27	$12 73	9.36
2. Lady Horace, . .	121 90	65 65	24 69	40 96	65 00	26 50	42 44	24 69	17 75	11.35
3. Daisy (1), . . .	108 41	56 46	21 95	34 51	60 00	25 00	38 90	21 95	16 95	12.80
4. Mollie, ...	93 74	56 04	22 24	33 80	60 00	25 00	24 94	22 24	2 70	8.12
5. Susie, ...	103 40	63 25	24 81	38 44	60 00	37 40	42 36	24 81	17 55	15.24
6. Meg, ...	97 01	59 50	23 84	35 67	60 00	37 54	38 88	23 83	15 05	14.90
7. Lizzie, ...	180 70	118 96	47 64	71 32	65 00	28 00	72 38	47 64	24 74	14.39
8. Ida, ...	75 83	80 08	30 28	49 80	55 00	25 00	—3 97	30 28	—34 25	—1.20
9. Minnie, ...	203 37	135 05	56 93	78 12	60 00	28 00	93 25	56 93	36 32	15.97
10. Daisy (2), . . .	136 33	88 33	37 94	50 39	72 50	35 00	48 44	37 94	10 50	13.13
11. May, ...	235 31	174 60	73 35	101 25	60 00	30 00	104 06	73 35	30 71	13.93
12. Melia, ...	191 00	130 51	54 50	76 01	65 00	30 00	79 99	54 50	25 49	14.06
Averages, . . .	$138 23	$90 62	$36 70	$53 92	$62 29	$29 38	$51 40	$36 70	$14 70	11.83

Average cost of cow (twelve), ...	$62 29	
Average selling price of cow, ...	29 38	
Average of total cost of feed per day, ...	21.54	cents.
Average product per day for entire observation, per head, ...	11.06	quarts.
Average of net cost of feed per day, ...	12.94	cents.
Average of value received above net cost of feed and of cow, per day, ...	12.33	cents.
Average of value received in form of manure, per day,	8.81	cents.
Average of value received in form of cash, per day, .	3.52	cents.

The average yield of milk at the end of the ninth month, since day of calving, was sixty-one per cent. of original yield. The shrinkage in the temporary market value of cow varies from five to eleven and four-tenths cents per day, and averages eight cents per head in our case.

The net cost of the feed consumed is obtained by deducting eighty per cent. of the current commercial value of the essential fertilizing constituents contained in the feed from the market cost of the feed. See —

Bessie.

Market value of feed consumed, ...	$59 00
Value of manure obtainable, ...	22 27
Net cost of feed, ...	$36 73

The total value obtained for the feed consumed is ascertained by adding the value secured from the sale of milk produced to the commercial value represented in the manure obtainable. See —

Bessie.

Value of milk sold, ...	$111 73
Value of eighty per cent. of the manurial substances in the feed, ...	22 27
Total value obtained from feed consumed, ...	$134 00

The total value secured from any individual cow, after net cost of feed and of cow has been accounted for, is represented by subtracting the sum resulting from the addition of the difference between the original cost of the cow and its selling price, and of the total cost of feed consumed, from the total value obtained in form of milk and manurial refuse. See —

Bessie.

Original cost of cow,	$65 00
Selling price of cow,	25 00
Difference,	$40 00
Loss on cow,	$40 00
Total cost of feed,	59 00
	$99 00
Total value obtained from feed,	$134 00
Total cost of feed and loss on cow,	99 00
Net return for feed,	$35 00

It seems to be scarcely necessary to add that the above estimates refer only to the cost of feed and of the cow, and do not include cost of labor, housing, interest and risk of life of animal, etc.

6. *Some Conclusions suggested by the Preceding Financial Record.*

1. The total value received above net cost of feed and of cow does in no instance exceed 15.97 cents per day; its average in eleven cases is 13.02 cents. There is an actual loss of 1.2 cents per day in one case (No. 8), where the average daily yield of milk for the entire period of observation (331 days) is as low as 7.7 quarts.

2. The total value received above net cost of feed and of cow consists in every instance in a controlling degree on the manure obtainable. In No. 8 it prevents a serious loss, while in No. 4 it represents practically the entire gain; in some instances it amounts to from three-fourths to two-thirds (Nos. 12 and 3), and in none as low as one-half of the total value secured.

3. As the value of the manure depends in a controlling degree on the amount of fertilizing constituents contained in the feed, it becomes apparent that this point ought to be seriously considered when selecting suitable fodder articles for a remunerative daily diet of dairy cows. The table containing the valuation of the essential fertilizing constituents of the fodder articles used in our experiments is very sug-

gestive in this connection, when compared with the preceding statements of respective market prices of the latter.

4. Recognizing the correctness of the preceding conclusion, it is evident that the most serious attention ought to be bestowed on collecting and preserving the manurial refuse obtained in connection with the production of milk; for it depends largely on a judicious management of that matter, how much of the stated manurial value will be actually secured. The liability of a loss in the manurial value of the refuse matter renders it advisable, for financial reasons, not to depend on too close a margin of cash returns.

5. Although it will be conceded that the dairy cow, aside from the special service, is a most important factor in mixed farm management, as far as an economical disposition of home-raised fodder crops and a liberal production of home-made manure are concerned, yet, when reduced to a mere manure-producing medium, this value may be well questioned from a financial stand-point.

6. A cow whose total milk record averages not more than from seven to eight quarts per day, judging from our own conditions, promises to prove a better investment when prepared for the meat market than when constituting a liberal proportion of the stock kept for supplying the general milk market at stated prices.

IV. CREAMERY RECORD OF THE STATION DURING THE YEARS 1887, 1888 AND 1889; AND SOME OBSERVATIONS MADE DURING VISITS TO THE PATRONS OF TWO CREAMERIES IN OUR VICINITY.

In preceding pages has been stated the financial record of twelve cows, grades which had served during past years for feeding experiments at the station. It was stated in that connection that the primary object at that time was to test the comparative merits of corn fodder, corn stover, corn ensilage and root crops, in the whole or in part, as circumstances advised, as substitutes for a good meadow hay, as far as quantity, quality and cost of production of milk are concerned. The cows selected for that investigation, were, for stated reasons, of moderate milking qualities. Our financial records, although obtained under somewhat exceptional circumstances, are published with full recognition of that point, considering them not without some interest to others studying the financial side of the dairy industry in its varying aspects.

The subsequent communication contains a discussion of our creamery record, which covers, to a considerable extent, the time when the above-mentioned milk record was obtained. The milk was weighed at the station, and the cream secured and measured by means of a Cooley creamery apparatus. A copy of the daily record was kept in our dairy room by the agent of the creamery. Two quarts of milk used daily for family purposes are accounted for in our calculations of total results. Analyses of milk were made where a change of daily diet rendered it advisable.

The cost of feed consumed is based on the same market price of the various ingredients as was adopted in the preceding milk record. The same is true in regard to the valuation of the whole milk, — three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are also based upon those given in connection with the preceding milk record.

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved; for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock, and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.

1. Statement of Articles of Fodder used during 1887, 1888 and 1889 (in Pounds).

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Potatoes.	Carrots.	Sugar Beets.
1887.																
January, . .	299.0	–	299.0	–	299.0	366.0	–	184.5	–	2,590.0	–	–	–	–	–	–
February, .	523.5	–	523.5	–	409.5	1,630.0	–	–	467.5	–	–	–	–	–	–	4,255.0
March, .	585.0	–	585.0	–	585.0	390.0	2,975.0	–	115.0	–	–	–	–	–	–	663.5
April, . .	585.0	–	481.0	101.0	585.0	3,550.0	–	–	–	–	–	–	–	–	–	–
May, . .	466.0	–	81.5	637 0	130.0	2,860 0	–	–	–	–	–	–	–	–	–	–
June, . .	549.5	–	549.0	–	–	3,380.0	–	–	–	–	–	–	–	–	–	–
July, . .	598.0	–	552.5	–	–	2,521.5	–	–	–	–	3,415.0	–	–	–	–	–
August, .	572.0	–	572.0	–	–	2,494.0	–	–	–	–	–	–	6,150.0	–	–	–
September, .	585.0	–	585.0	–	–	2,660.5	–	–	–	–	–	7,185.0	735.0	–	–	–
October, .	604.5	–	604.5	–	–	4,368.5	–	–	–	–	–	–	–	–	–	–
November, .	585.0	–	585.0	–	–	212.5	4,194.5	–	–	–	–	–	–	570.0	–	–
December, .	590.0	–	589.5	–	24.0	1,183.0	3,023.5	–	–	–	–	–	–	620.0	–	–
1888.																
January, .	280.0	282.0	562.5	–	522.5	3,378.0	–	–	–	–	–	–	–	–	–	–
February, .	–	565.5	565.5	–	565.5	1,155.0	–	2,064.0	–	225.0	–	–	–	–	–	–
March, .	–	604.5	604.5	–	604.5	1,307.5	–	79.5	–	5,094.0	–	–	–	–	–	–
April, . .	–	585.0	585 0	–	585.0	1,050.0	–	1,319.5	–	1,303.5	–	–	–	–	–	–
May, . .	–	604.5	604.5	–	510.0	3,600.0	–	27.0	–	–	–	–	–	–	–	551.0

1. STATEMENT OF ARTICLES OF FODDER USED DURING 1887, 1888 AND 1889 (IN POUNDS)—*Concluded.*

	Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Mid-dlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Pota-toes.	Carrots.	Sugar Beets.
June, . .	–	585.0	585.0	–	291.0	3,600.0	–	–	–	–	–	–	–	–	–	–
July, . .	413.0	117.0	530.0	–	530.0	2,054.0	–	–	–	–	4,730.5	–	–	–	–	–
August, .	504.0	–	504.0	–	504.0	620.0	2,534.0	–	–	–	–	–	–	–	–	–
September, .	510.0	–	510.0	–	510.0	2,148.5	–	–	–	–	–	–	3,970.0	–	–	–
October, .	575.5	–	575.5	–	575.5	3,431.0	–	–	–	–	–	–	–	–	–	–
November, .	585.0	–	585.0	–	585.0	1,845.0	–	1,318.5	–	–	–	–	–	–	–	–
December, .	588.5	–	588.5	–	588.5	223.0	–	1,183.0	1,488.5	–	–	–	–	–	461.0	–
1889.																
January, .	608.75	–	604.75	–	584.75	1,772.00	–	–	–	1,475.00	–	–	–	–	4,868.00	–
February, .	552.50	–	552.50	–	552.50	1,268.50	–	–	–	5,069.50	–	–	–	–	–	–
March, .	591.50	–	591.50	–	591.50	2,396.00	–	–	–	–	–	–	–	–	–	4,081.00
April, . .	572.00	–	562.25	–	563.88	2,395.50	838.00	–	–	–	–	–	–	–	–	1,125.00
May, . .	604.50	–	583.38	–	604.50	900.50	2,713.50	–	–	–	–	–	–	–	–	–
June, . .	585.00	–	585.00	–	585.00	1,858.50	1,295.50	–	–	–	582.75	–	–	–	–	–
July, . .	604.50	–	604.50	–	604.50	434.00	1,871.00	–	–	–	4,308.75	–	–	–	–	–
August, .	402.00	–	402.00	–	402.00	180.00	3,755.25	–	–	–	–	–	1,512.00	–	–	–
September, .	585.00	–	585.00	–	585.00	1,002.00	–	–	–	–	–	8,182.50	4,983.00	–	–	–
October, .	604.50	–	604.50	–	604.50	3.574.50	–	–	–	–	–	–	–	–	–	–

2. (*A*) RECORD OF AVERAGE QUALITY OF MILK AND OF FODDER RATIONS (1887).

1887.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	FEED CONSUMED PER DAY (IN POUNDS).													
					Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January, .	12.38	3.45	2.17	1 : 6.20	3.25	–	3.25	–	3.25	5.00	–	–	–	29.00	–	–	–	–
February, .	13.13	4.07	2.02	1 : 5.90	3.25	–	3.25	–	3.25	10.00	–	–	–	–	–	–	–	35.00
March, .	13.13	3.97	2.19	1 : 6.20	3.25	–	3.25	–	3.25	–	20.00	–	–	–	–	–	–	–
April, .	12.84	3.73	2.42	1 : 6.10	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
May, } .	13.31	4.13	1.80	1 : 9.15	3.25	–	–	6.25	–	20.00	–	–	–	–	–	–	–	–
June, }			1.82	1 : 8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
July, . .	13.11	4.28	1.97	1 : 8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
				1 : 6.94	3.25	–	3.25	–	–	5.00	–	–	–	–	62.00	–	–	–
August, .	12.70	3.78	1.73	1 : 8.54	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–	–	–
				1 : 5.19	3.25	–	3.25	–	–	5.00	–	–	–	–	–	–	98.00	–
September,	13.04	4.04	1.74	1 : 5.40	3.25	–	3.25	–	–	5.00	–	–	–	–	–	98.00	–	–
				1 : 8.75	3.25	–	3.25	–	–	24.00	–	–	–	–	–	–	–	–
October, .	13.54	4.50	1.63	1 : 8.75	3.25	–	3.25	–	–	24.00	–	–	–	–	–	–	–	–
November,	–	–	1.97	1 : 5.99	3.25	–	3.25	–	–	–	27.00	–	–	–	–	–	–	–
December, .	13.16	4.24	1.67	1 : 5.99	3.25	–	3.25	–	–	–	27.00	–	–	–	–	–	–	–
Averages, .	13.01	4.00	1.93															

2. (*B*) Record of Average Quality of Milk and of Fodder Rations (1888).

1888.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds).													
					Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Corn Stover (Dry).	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January, .	13.18	4.08	1.58	1 : 6.1	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
February, .	13.98	3.67	1.75	1 : 6.2	–	3.25	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
March, . .	13.77	3.79	1.71	1 : 5.5	–	3.25	3.25	–	3.25	7.50	–	–	–	30.00	–	–	–	–
April, . .	13.83	4.00	1.73	1 : 5.5	–	3.25	3.25	–	3.25	7.50	–	–	–	30.00	–	–	–	–
				1 : 6.2	–	3.25	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
May, . .	–	–	1.67	1 : 5.9	–	3 25	3.25	–	3.25	20.00	–	–	–	–	–	–	–	–
June, . .	–	–	1.76	1 : 7.3	–	3.25	3.25	–	1.50	20.00	–	–	–	–	–	–	–	–
July, . .	13.04	3.14	1.93	1 : 5.5	3.25	–	3.25	–	3.25	5.00	–	–	–	–	60.00	–	–	–
August, .	12.87	3.86	1.83	1 : 5.9	3.25	–	3.25	–	3.25	–	20.00	–	–	–	–	–	–	–
September,	13.26	3.79	1.85	1 : 6.1	3.25	–	3.25	–	3.25	19.00	–	–	–	–	–	–	–	–
				1 : 4.5	3.25	–	3.25	–	3.25	5.00	–	–	–	–	–	–	78.00	–
October, .	–	–	1.72	1 : 6.3	3.25	–	2.25	–	3.25	20.00	–	–	–	–	–	–	–	–
November,	14.39	4.55	1.63	1 : 6.3	3.25	–	3.25	–	3.25	20.00	–	–	–	–	–	–	–	–
				1 : 6.2	3.25	–	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
December, .	14.78	4.86	1.43	1 : 6.2	3.25	–	3.25	–	3.25	–	–	20.00	–	–	–	–	–	–
				1 : 6.7	3.25	–	3.25	–	3.25	–	–	–	22.00	–	–	–	–	–
Averages,	13.68	3.97	1.72															

2. (*C*) RECORD OF AVERAGE QUALITY OF MILK AND OF FODDER RATIONS (1889).

1889.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed per Day (in Pounds).													
					Corn Meal.	Corn and Cob Meal.	Wheat Bran.	Rye Middlings.	Gluten Meal.	Hay.	Rowen.	Corn Fodder (Dry).	Carrots.	Corn Ensilage.	Vetch and Oats.	Serradella.	Cow-pea.	Sugar Beets.
January, .	14.49	3.90	1.76	1:6.21	3.25	-	3.25	-	3.25	10.00	-	-	39.57	-	-	-	-	-
February, .	13.93	4.29	1.74	1:6.57	3.25	-	3.25	-	3.25	5.00	-	-	-	36.51	-	-	-	-
March, . .	14.12	4.36	1.65	1:5.99	3.25	-	3.25	-	3.25	16.40	-	-	-	-	-	-	-	-
				1:6.14	3.25	-	3.25	-	3.25	10.00	-	-	-	-	-	-	-	45.60
April, . .	14.14	4.56	1.62	1:6.12	3.25	-	3.25	-	3.25	18.38	-	-	-	-	-	-	-	-
May, . .	14.03	4.34	1.60	1:5.21	3.25	-	3.25	-	3.25	-	19.53	-	-	-	-	-	-	-
June, . .	14.42	4.58	1.62	1:5.30	3.25	-	3.25	-	3.25	-	20.60	-	-	-	-	-	-	-
				1:6.18	3.25	-	3.25	-	3.25	18.00	-	-	-	-	-	-	-	-
July, . .	13.92	4.30	1.72	1:6.38	3.25	-	3.25	-	3.25	5.00	-	-	-	46.50	-	-	-	-
				1:5.30	3.25	-	3.25	-	3.25	-	20.60	-	-	-	-	-	-	-
August, .	13.85	4.21	1.70	1:5.62	2.00	-	2.00	-	2.00	-	24.10	-	-	-	-	-	-	-
September,	13.82	4.48	1.65	1:6.05	3.25	-	3.25	-	3.25	5.00	-	-	-	-	-	76.23	-	-
				1:4.70	3.25	-	3.25	-	3.25	5.00	-	-	-	-	78.23	-	-	-
October, .	14.34	4.72	1.53	1:6.26	3.25	-	3.25	-	3.25	19.30	-	-	-	-	-	-	-	-
Averages,	14.11	4.37	1.66															

3. VALUE OF CREAM PRODUCED AT CREAMERY BASIS OF VALUATION.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1887.					
January,	$16 21	$9 69	$0 27	$6 79	$17 24
February,	40 39	17 76	69	23 32	38 85
March,	46 93	27 10	71	20 54	40 20
April,	46 34	22 68	57	24 23	31 14
May,	36 02	15 34	64	21 32	32 47
June,	37 57	16 87	66	21 36	30 03
July,	36 42	16 93	59	20 08	27 69
August,	41 09	14 94	68	26 83	35 91
September,	45 48	22 54	69	23 63	36 30
October,	46 21	20 66	64	26 19	36 30
November,	47 97	27 02	52	21 47	29 48
December,	47 01	25 08	60	22 53	35 23
Averages,	$40 60	$19 72	$0 61	$21 52	$32 57
1888.					
January,	$43 53	$21 42	$0 76	$22 87	$45 76
February,	32 51	20 05	73	13 19	44 00
March,	35 44	20 05	69	16 08	40 91
April,	31 71	19 19	65	13 17	35 99
May,	47 06	22 63	65	25 08	34 23
June,	42 69	20 11	58	23 16	28 67
July,	39 66	20 63	63	19 66	30 94
August,	40 66	23 64	61	17 63	32 48
September,	39 57	21 42	57	18 72	32 02
October,	45 15	22 44	62	23 33	35 92
November,	36 95	21 03	64	16 56	37 67
December,	29 82	17 97	59	12 44	34 67
Averages,	$38 73	$20 88	$0 64	$18 49	$36 11
1889.					
January,	$52 21	$21 23	$0 66	$31 64	$40 60
February,	33 86	19 15	63	15 34	36 19
March,	48 14	21 77	75	27 11	42 48
April,	46 17	23 40	78	23 55	42 84
May,	47 28	27 23	83	20 88	39 28
June,	44 21	23 98	72	20 95	33 06
July,	43 63	25 28	76	19 11	34 92
August,	45 44	27 54	76	18 66	36 33
September,	48 01	28 08	73	20 66	38 25
October,	37 21	23 47	71	14 45	39 06
Averages,	$44 62	$24 11	$0 73	$21 24	$38 31

4. COST OF SKIM-MILK AT THE SELLING PRICE OF THREE CENTS PER QUART FOR WHOLE MILK.

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1887.								Cents.	
January, .	976.2	445	130.9	845.3	3.88	1.76	$17 24	1.43	$12 05
February, .	2,093.1	1,036	304.7	1,788.4	3.75	1.86	38 85	1.34	23 94
March, . .	2,352.7	1,072	315.3	2,037.4	3.75	1.71	40 20	1.43	30 38
April, . .	2,083.4	859	252.6	1,830.8	3.63	1.50	31 14	1.71	31 36
May, . .	1,729.0	962	282.9	1,446.1	3.38	1.88	32 47	1.34	19 40
June, . .	1,818.7	1,001	294.4	1,524.3	3.00	1.65	30 03	1.61	24 53
July, . .	1,749.7	886	260.6	1,489.1	3.13	1.58	27 69	1.67	24 80
August, .	1,772.6	1,026	301.8	1,470.8	3.50	2.03	35 91	1.17	17 27
September, .	1,808.4	1,037	305.0	1,503.4	3.50	2.01	36 30	1.19	17 95
October, .	1,574.4	968	284.7	1,289.7	3.75	2.31	36 30	0.85	10 93
November, .	1,545.6	786	231.2	1,314.4	3.75	1.91	29 48	1.28	16 89
December, .	1,522.3	909	267.3	1,255.0	3.88	2.31	35 23	0.83	10 44
Averages, .	1,752.2	916	269.3	1,482.9	3.58	1.89	$32 57	1.32	$19 99
1888.									
January, .	1,807.5	1,144	336.5	1,471.0	4.00	2.53	$45 76	0.58	$8 47
February, .	1,925 8	1,100	323.5	1,602.3	4.00	2.28	44 00	0.86	13 77
March, . .	1,794.5	1,049	308.5	1,486.0	3.90	2.28	40 91	0.87	12 93
April, . .	1,702.5	986	290.0	1,412.5	3.65	2.11	35 99	1.07	15 09
May, . .	1,638.1	978	287.6	1,350.5	3.50	2 10	34 23	1.10	14 91
June, . .	1,553.9	882	259.4	1,294.5	3.25	1.85	28 67	1.39	17 95
July, . .	1,841.5	952	280.0	1,561.5	3.25	1.68	30 94	1.56	24 31
August, .	1,696.9	928	272.9	1,424.0	3.50	1.91	32 48	1.29	18 43
September, .	1,580.1	854	251.2	1,328.9	3.75	2.03	32 02	1.16	15 38
October, .	1,606.8	933	274.4	1,332.4	3.85	2.24	35 92	1.00	12 28
November, .	1,576.0	966	284.1	1,291.9	4.00	2.39	37 67	0.74	9 61
December, .	1,270.3	889	261.5	1,008.8	4.00	2.73	34 67	0.34	3 44
Averages, .	1,666.2	972	285.8	1,380.4	3.72	2.18	$36 11	1.00	$13 88
1889.									
January, .	1,791.1	1,015	298.5	1,492.6	4.00	2.27	$40 60	0.88	$13 13
February, .	1,680.0	965	283.8	1,396.2	3.75	2.15	36 19	1.02	14 21
March, . .	1,895.0	1,148	337.6	1,557.4	3.70	2.24	42 48	0.92	14 37
April, . .	1,931.6	1,190	350.0	1,581.6	3.60	2.22	42 84	0.96	15 11
May, . .	2,025.2	1,267	372.6	1,652.6	3.10	1.94	39 28	1.30	21 48
June, . .	1,785.6	1,102	324.1	1,461.5	3.00	1.85	33 06	1.40	20 51
July, . .	2,001.2	1,164	342.4	1,658.8	3.00	1.74	34 96	1.51	25 12
August, .	1,991.9	1,172	344.7	1,647.2	3.10	1.82	36 33	1.42	23 43
September, .	1,856 0	1,125	330.9	1,525.1	3.40	2.06	38 25	1.14	17 43
October, .	1.665.0	1,085	319.1	1,345 9	3.60	2.35	39 06	0.81	10 89
Averages, .	1,862.3	1,123	330.4	1,531.9	3.43	2.06	$38 31	1.14	$17 57

5. Fertilizing Constituents of Cream.

[Average analysis.]

	Per Cent.
Moisture at 100° C.,	75.22
Nitrogen (16½ cents per pound),	.54
Potassium oxide (4¼ cents per pound),	.123
Phosphoric acid (6 cents per pound),	.168

6. Some Conclusions drawn from the Preceding Records.

1. The relative proportion of digestible nitrogenous and non-nitrogenous constituents consumed differs on the whole in a larger degree during the year 1887 than in 1888. During one-half of the year 1887 it ranged above 1 : 8.5 ; during the year 1888 it reached 1 : 7.3 in only one case, and for six of the remaining months it was below 1 : 6 (nutritive ratio). In 1889 it was in one case only 1 : 6.59, while in all others it resembled quite closely those of the preceding year. The different nutritive ratios averaged, for the year 1887, 1 : 7.08 ; for the year 1888, 1 : 6.00 ; for the year 1889, 1 : 5.80.

2. The amount of fat in the milk varied, during the year 1887, from 3.45 to 4.50 per cent., with an average of 4.00 per cent. ; during the year 1888 it varied from 3.14 to 4.86 per cent., with an average of 3.97 per cent. ; while during the year 1889 it varied from 3.90 to 4.72 per cent., with an average of 4.37 per cent.

3. The quantity of milk, in quarts, required to produce one space of cream, during the year 1887, varied from 2.42 to 1.63, and amounted, on the average, to 1.93 quarts for the entire year ; during the year 1888 it varied from 1.93 to 1.43, averaging for the year 1.72 quarts ; and during the year 1889 it varied from 1.76 to 1.53 quarts, with an average of 1.66 quarts.

4. The value received for one space of cream during the year 1887 varied from 3.00 to 3.88 cents, with an average of 3.58 cents ; during the year 1888 from 3.25 to 4.00 cents were received for each space, with an average of 3.72 cents ; which would equal 12.17 cents per quart of cream for 1887 and 12.65 cents for 1888. During the year 1889 the money value allowed by the creamery for one space of cream varied from 3.00 to 4.00 cents, with an average of 3.43 cents, or 11.66 cents per quart.

5. The total cost of feed consumed for the production of one quart of cream amounted for the year 1887 to 15.09 cents, for the year 1888 to 13.55 cents, and for the year 1889 the same as in 1888.

6. The value of fertilizing constituents which are lost to the farm by the sale of cream produced, amounted, according to the analyses of our cream, during the year 1887 to 3.09 per cent., during 1888 to 3.65 per cent., and in 1889 to 3.03 per cent., of the total fertilizing value of the feed. From these figures it will be seen that in selling the cream from the farm much less fertilizing constituents are lost to the farm than in selling the whole milk. A loss of twenty per cent. of the fertilizing constituents contained in the feed has been allowed in our previous publications, when selling the whole milk. The statement of net cost of feed, as compared with that of its total cost, refers to the original cost of the feed less the value of fertilizing constituents obtainable in manure.

7. The net cost of feed consumed per quart of cream (1 quart = 3.4 spaces) averaged, for the year 1887, 8 cents; for the year 1888, 6.47 cents, and for the year 1889, 6.4 cents. As we obtained 12.17 cents per quart of cream during 1887, 12.65 cents during 1888, and 11.5 cents in 1889, we secured a profit above net cost of feed of 4.17 cents per quart in 1887; in the year 1888, 6.18 cents; and in 1889, 5.1 cents, for the same quantity.

8. We produced, during the year 1887, 1,752.2 quarts of whole milk per month; during the year 1888, 1,662.2 quarts; and in 1889, 1,862.3 quarts. It required, on an average, 6.51 quarts of whole milk to produce one quart of cream during 1887, 5.83 quarts during 1888, and 5.64 quarts during 1889. We secured, on an average per month during 1887, 1,482.9 quarts of skim-milk and 269.3 quarts of cream; in 1888, 1,380.4 quarts of skim-milk and 285.8 quarts of cream; and in 1889, 1,531.9 quarts of skim-milk and 330.4 quarts of cream.

9. Counting the whole milk at three cents per quart, then skim-milk has cost us, on an average, during the year 1887, 1.32 cents per quart; during the year 1888, 1.00 cent per quart; and in 1889, 1.14 cents per quart. The cost of

skim-milk varied considerably during different months of the year, mainly on account of the changes in the valuation of the cream. During 1887, the cost of skim-milk varied from .83 to 1.71 cents per quart; in 1888, from .34 to 1.56 cents per quart; and in 1889, from .81 to 1.51 cents per quart.

The feeding value of skim-milk containing 9.5 per cent. of solids, is stated by good authority to stand in the relation of 3.1 to 4, when compared in that respect with whole milk. In case an average whole milk is charged at three cents per quart, skim-milk would be worth, on the previously stated basis, 2.33 cents. The feeding value of skim-milk, estimated on the customary basis of 4.33 cents per pound of digestible nitrogenous substances and of fat, and .9 cents for non-nitrogenous substances, would amount, per gallon, to 1.91 cents.

We have bought, during the past years, creamery butter-milk containing from 7 to 8 per cent. of solids, at 1.37 cents per gallon. (See third annual report, page 42.) Our own skim-milk, with 9.5 per cent. of solids, would represent, on this basis, a value of 1.75 cents per gallon, or .44 cents per quart.

Some Facts concerning Two Creameries.

It seemed of interest to us to learn from personal observation some facts concerning the supply of cream to some creameries in our vicinity. By the courtesy of the officers in charge of these establishments, Mr. Edward R. Flint, assistant in the chemical department of the station, has been permitted to accompany the collectors of cream at their round trips, and to take notes as directed. He has visited at different times all the patrons of these creameries, in all, 193 farms. Cream and butter have been repeatedly tested. The results of our work in this connection are embodied in a few subsequent pages.

Creamery A.

This creamery receives 350 gallons of cream per day, from 129 farms. This is set for sixteen hours at a temperature of 64 degrees F., together with a small amount of sour cream to hasten the ripening process. The cream is then churned for one hour at a temperature of 64 degrees F., and washed twice with clear water. It is worked once, at which time it is salted at the rate of one ounce of salt per pound. The product of this creamery is about 4,200 pounds per week; 6.13 spaces of cream are considered to make a pound of butter.

Creamery B.

This creamery receives 200 gallons of cream per day, from 64 farms. This is set in one vat for twenty-four hours, at a temperature of 60 degrees F. It is then churned for one hour at 65 degrees F., and washed twice in the churn with clear water. It is worked twice, 1½ ounces of salt per pound being added when first worked. This creamery produces 1,850 pounds of butter per week. A little less than six spaces are considered to make a pound of butter.

Butter samples from creameries A and B show the following results of analysis: —

Creamery A.

Collected.	Moisture.	Butter Fat.	Casein.	Salt.
1889.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
September 6, . . .	12.35	81.54	.80	5.13
10, . . .	11.73	81.43	.70	6.45
16, . . .	12.68	81.65	.71	4.93
18, . . .	11.02	83.32	.51	3.97
21, . . .	11.04	81.79	.60	4.55
23, . . .	10.54	84.35	.54	4.04
25, . . .	12.31	82.40	.52	5.04
26, . . .	12.95	82.21	.60	4.63
October 28, . . .	12.52	82.62	.58	4.28
29, . .	12.78	87.37	.55	Trace.
30, . . .	11.48	83.69	.64	4.30
31, . . .	11.76	82.17	.88	4.45
Average, . . .	11.93	82.88	.64	4.31

Creamery B.

Collected.	Moisture.	Butter Fat.	Casein.	Salt.
1889.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
September 27, . . .	10.77	84.09	.64	5.92
30, . . .	11.00	84.25	.56	5.60
October 1, . . .	9.88	83.15	.56	4.76
3, . . .	7.43	86.64	.58	4.53
17, . . .	9.22	85.00	.75	5.11
18, . . .	9.51	84.10	.62	5.32
21, . . .	11.90	84.00	.89	4.15
22, . . .	10.37	84.01	.63	3.61
November 1, . . .	9.21	86.33	.70	4.12
4, . . .	10.12	86.74	.72	5.90
5, . . .	10.14	83.51	.70	5.63
7, . . .	7.11	89.05	.62	3.96
Average, . . .	9.64	85.07	.66	4.72

Cream samples from creameries A and B show the following results of analysis: —

Creamery A.

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 6, ...	24.34	16.86	7.48
10, ...	23.75	16.69	7.06
16, ...	24.25	17.15	7.10
18, ...	23.68	16.39	7.29
21, ...	23.66	15.86	7.80
23, ...	24.58	18.53	6.05
25, ...	24.91	13.74	11.17
26, ...	23.54	15.72	7.82
October 26, ...	23.38	16.51	6.87
29, ...	25.17	18.70	6.47
30, ...	24.96	17.38	7.58
November 6, ...	24.44	18.23	6.21
8, ...	24.60	16.94	7.66
December 10, ...	23.73	15.95	7.78
13, ...	24.91	16.75	8.16
14, ...	24.04	15.73	8.31
26, ...	24.87	16.24	8.63
27, ...	23.81	15.58	8.23
Average, ...	24.26	16.61	7.65

Creamery B.

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 27,	22.65	15.80	6 85
30,	24.37	16.77	7.60
October 1,	22.89	15.67	7.22
3,	23 24	16.05	7.19
17,	23.58	16.54	7.04
18,	23.50	16.24	7.26
21,	23.91	16.98	6.93
22,	22.82	16.06	6.76
November 1,	22 81	15.26	7.43
4,	23.24	15.81	7 52
5,	23.80	16.28	7.53
7,	24.72	17.40	7.32
December 12,	23.38	15.08	8.30
Average,	23.45	16.13	7.30

Analyses of Cream from the station dairy, from samples collected during the time of collection from the creameries, the grain feed consisting of three and one-quarter pounds corn meal, three and one-quarter pounds bran, and three and one-quarter pounds gluten meal; the coarse feed of five pounds hay, seventy-five pounds serradella (green).

Collected.	Solids.	Fat.	Solids not Fat.
1889.	Per Cent.	Per Cent.	Per Cent.
September 6,	28 09	20.33	7.76
11,	24.65	17 91	6.74
17,	25.25	18.95	6.30
18,	27.65	20.42	7.23
21,	27 20	20.51	6.69
24,	27.27	20.16	7.11
25,	26 21	18.32	7.89
26,	26.18	17.13	9.05
Average,	26.56	19.22	7.34

Summary of Butter and Cream Analyses.

Butter.

	Moisture.	Butter Fat.	Casein.	Salt.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Average of Creamery A,.	11.93	82.88	.64	4.31
Average of Creamery B,.	9.64	85.07	.66	4.72

Cream.

	Solids.	Fat.	Solids not Fat.
	Per Cent.	Per Cent.	Per Cent.
Average of Creamery A, .	24.26	16.61	7.65
Average of Creamery B, .	23.45	16.13	7.30
Average of Station Dairy, .	26.56	19.22	7.34

Details of Farms contributing to Creamery A.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
1	4	–	17	–	4.25	–	5½	Three pure, one grade Jersey, .	Hay, corn fodder, pumpkins, .	None, . . .	– –	1	2	1
2	13	13	38	48	2.92	3.69	4	Pure and grade Jersey, . .	Rowen, hay, corn stalks, . .	4 qts. cob meal and rye,	Same, ...	–	6	5
3	7	5	28	20	4	4	4½	Jersey and native, . . .	Pasture (Nov.), rowen, stover, .	None, . . .	4 qts. meal and bran, . .	1	3	2
4	5	5	10	13	2	2.60	4	Grade Jersey, ...	Hay, corn fodder, . . .	4 qts. bran, . .	Same, ...	2	6	–
5	11	10	45	32	4.09	3.20	7	Pure and grade Jersey, Holstein, native, ...	Pasture (Nov.), hay, . . .	None, . . .	4 qts. bran, ...	–	5	–
6	2	6	10	21	5	3.50	7½	Grade Jersey, ...	Pasture (Nov.), soft corn, hay, .	None, . . .	4 qts. meal and bran, . .	4	2	–
7	5	6	13	29	2.60	4.83	6	Grade Durham, ...	Hay, corn fodder, . . .	Meal and bran, . .	8 qts. cob meal and bran, .	5	1	–
8	18	20	59	77	3.28	3.85	5	Grade Jersey, Holstein, Durham, Guernsey, . . .	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, with 1 qt. linseed, .	11	6	3
9	9	4	21	9	2.33	2.25	6½	Grade Jersey, Guernsey, native,	Rowen, corn stover, . . .	4 qts. cob meal and rye,	Same, ...	–	–	9
10	4	4	17	14	4.25	3.50	5	Grade Jersey, ...	Hay, sugar beets, . . .	4 qts. meal and bran,	Same, ...	1	3	–
11	9	12	31	55	3.33	4.51	7	Grade Jersey, Durham, native,	Pasture (Nov.), rowen, hay, .	2 qts. meal, . .	4 qts. bran, cotton seed, corn,	9	3	–
12	12	12	36	37	3	3.08	6½	Grade Durham, ...	Hay, corn fodder, . . .	4 qts. cob meal, .	5 qts. meal and bran, . .	1	6	5
13	15	17	48	52	3.20	3.06	6½	Grade Jersey, Holstein, native,	Hay, corn fodder, . . .	5 qts. meal, bran, rye,	Same, with broom seed, .	3	4	10

Details of Farms contributing to Creamery A — Continued.

FARM NUMBER.	NUMBER OF COWS.		SPACES OF CREAM.		SPACES PER COW.		Average Age of Cows.	BREED.	COARSE FEED.	GRAIN FEED.		NUMBER OF MONTHS SINCE LAST CALF.		
	November.	December.	November.	December.	November.	December.				November.	December	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
14	5	7	17	–	3.40	–	7	Grade Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	2	5	–
15	24	24	86	82	3.58	3.41	5½	Grade Jersey, Holstein, native,	Rowen, corn fodder,	2 qts. bran, 4 qts. cob meal,	Same,	–	24	–
16	3	–	14	16	4.67	–	4	Grade Durham, Holstein,	Pasture (Nov.), hay,	3 qts. corn, rye, oats,	–	2	1	–
17	6	6	25	23	4.17	3.83	8	Grade Jersey, Durham, Holstein,	Hay, corn fodder,	5 qts. meal and bran,	Same,	–	3	3
18	10	10	47	19	4.70	1.90	8	Grade Durham,	Hay, corn fodder,	None,	None,	1	9	–
19	3	4	20	19	6.67	4.75	6	Grade Jersey and Ayrshire,	Pasture (Nov.) hay,	2 qts. meal and bran,	Same,	3	1	–
20	4	4	12	19	3	4.75	5	Grade Jersey, Holstein, native,	Pasture (Nov.), rowen, hay,	None,	6 qts. bran,	2	2	–
21	4	12	17	39	4.25	3.25	6	Grade Durham, Holstein,	Rowen, hay,	2 qts. bran,	8 qts. meal and bran,	2	7	3
22	8	8	23	27	4.13	3.38	4½	Grade Durham, Holstein,	Pasture, soft corn (Nov.), hay,	None,	4 qts. meal,	–	4	4
23	4	4	20	16	5	4	5½	Grade Jersey, native, Durham,	Pasture, soft corn (Nov.), hay, corn fodder,	None,	6 qts. cob meal,	1	2	1
24	9	9	30	31	3.34	3.44	6½	Native and grade Jersey,	Pumpkins (Nov.), hay, corn fodder,	4 qts. cob meal and bran,	3 qts. cob meal and bran,	–	5	4
25	3	6	18	34	6	5.67	5	Pure and grade Jersey,	Hay, corn fodder,	7 qts. cob meal and bran,	Same,	5	1	–

26	8	8	26	–	3.25	–	6½	Grade Jersey, ...	Pasture (Nov.), corn stover, hay,	None, . . .	Bran, ...	–	–	–
27	2	3	5	10	2.50	3.33	4	Grade Jersey, Ayrshire, . .	Rowen, soft corn, corn stover, .	None, . . .	2 qts. meal and bran, .	1	2	–
28	13	13	62	44	4.77	3.38	7½	Native, grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder, rowen, ...	None, . . .	3 qts. meal and bran, .	3	6	4
29	3	2	16	15	5.34	7.50	4	Grade Jersey, ...	Pumpkins (Nov.), hay, corn fodder, ...	None, . . .	3 qts. meal and bran, .	–	2	–
30	7	7	23	20	3.29	2.86	7	Pure Jersey, ...	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. cob meal and bran, .	2	1	4
31	4	4	27	20	6.75	5	6	Grade Jersey, native, . .	Pasture (Nov.), hay, corn fodder,	4 qts. corn, oats, bran,	Same, ...	4	–	–
32	4	4	11	–	2.75	–	8	Grade Jersey, ...	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same, ...	–	–	–
33	3	3	8	–	2.67	–	8	Grade Durham, Holstein, Jersey,	Pasture (Nov.), hay, . . .	None, . . .	None, ...	–	–	–
34	3	3	18	13	6	4.33	6	Pure and grade Jersey, . .	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. meal and bran, .	1	1	1
35	10	10	29	28	2.90	2.80	4	Grade Jersey, Durham, . .	Pasture (Nov.), hay, corn fodder,	None, . . .	None, ...	1	9	–
36	11	11	31	20	2.82	1.81	5½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. cob meal and rye, .	6	5	–
37	7	7	38	46	5.43	6.57	6	Grade Durham, Holstein, .	Hay, corn fodder, . . .	4 qts. clear meal, .	Same, ...	2	5	–
38	40	40	123	108	3.08	2.70	7½	Grade Durham, Holstein, .	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, ...	1	35	4
39	4	4	13	14	3.25	3.50	6½	Grade Durham, ...	Hay, corn fodder, . . .	4 qts. meal, oats and bran, . . .	Same, ...	1	3	–
40	14	18	39	45	2.79	2.50	6½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	None, . . .	4 qts. meal and bran, .	3	18	–
41	7	11	35	33	5	3	7	Grade Durham, ...	Rowen, corn fodder, . . .	None, . . .	4 qts. cob meal and bran, .	1	10	–
42	16	15	65	51	4.06	3.40	5	Grade Durham, Holstein, . .	Rowen, corn fodder, . . .	2 qts. bran, . . .	4 qts. meal, bran, rye, .	6	9	–
43	4	4	20	17	5	4.25	7	Native, ...	Pasture (Nov.), rowen, . .	3 qts. bran, . .	Same, ...	–	–	–
44	12	12	30	34	2.50	2.83	8	Grade Durham, ...	Rowen, hay, pumpkins (Nov.), corn fodder, ...	2 qts. malt sprouts, .	4 qts. bran, ...	10	2	–
45	3	6	16	40	5.34	6.67	5	Grade Jersey, native, . .	Sugar beets, hay, corn fodder, .	6 qts. meal and bran,	Same, ...	3	1	2

Details of Farms contributing to Creamery A — Continued.

Farm Number.	Number of Cows. November.	Number of Cows. December.	Spaces of Cream. November.	Spaces of Cream. December.	Spaces per Cow. November.	Spaces per Cow. December.	Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed. November.	Grain Feed. December.	Number of Months since Last Calf. Less than 3 mos.	Number of Months since Last Calf. 3 mos. to 9 mos.	Number of Months since Last Calf. More than 9 mos.
46	4	4	15	–	3.75	–	4½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, rowen,	4 qts. malt sprouts,	Bran,	1	3	–
47	16	16	82	45*	5.13	2.81	6	Grade Jersey, native,	Hay, corn fodder,	4 qts. clear meal,	Same,	8	6	–
48	4	4	15	17	3.75	4.25	5	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	None,	Bran and meal,	4	–	–
49	6	4	22	24	3.67	6	8	Pure Ayrshire, native, grade Holstein,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	2	2	4
50	6	6	13	25	2.17	4.17	5	Grade Jersey,	Pasture (Nov.), rowen, corn stover, hay,	None,	4 qts. meal and bran,	2	–	4
51	6	6	33	31	5.50	5.17	6	Grade Jersey, Durham, Ayrshire, Holstein,	Hay,	3½ lbs. each, bran, meal and gluten,	Same,	–	1	5
52	20	20	70	47	3.50	2.35	4½	Pure Jersey, Guernsey, Ayrshire, Holstein,	Hay,	8 qts. bran, oats, cotton seed,	Same,	–	–	–
53	3	3	12	9	4	3	6	Grade Jersey, Holstein,	Pasture (Nov.), hay, corn stover,	None,	None,	1	2	–
54	2	3	5	10	2.50	3.33	2	High-grade Jersey, Holstein,	Pasture (Nov.), hay, squashes,	None,	6 qts. meal and middlings,	–	3	–
55	6	6	14	17	2.33	2.83	8	Grade Jersey,	Pasture (Nov.), hay,	2 qts. meal,	Same,	1	4	1
56	13	15	22	43	1.69	2.87	6½	Grade Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn stover,	None,	4 qts. meal and bran,	6	8	1
57	5	9	21	38	4.20	4.22	4	High-grade Jersey, native,	Pasture (Nov.), hay,	2 qts. meal, oats, bran,	Same,	3	5	1
58	7	9	37	47	5.29	5.22	3½	Grade Jersey and Guernsey,	Pasture (Nov.), hay,	4 qts. provender,	4 qts. bran,	9	–	–

59	8	6	26	21	3.25	3.50	4	Grade Jersey, Guernsey, Durham, ...	Hay, corn fodder, . . .	4 qts. meal and bran,	Same, ...	3	1	2
60	6	5	33	14	5.50	2.80	6½	Grade Jersey, Durham, . .	Pasture (Nov.), rowen, oats, .	12 qts. meal and bran,	Same, ...	3	3	–
61	8	8	18	8	2.25	1	7	Grade Holstein, native, . .	Pasture (Nov.), hay, corn fodder,	None, . . .	None, ...	–	8	–
62	5	5	24	22	4.80	4.40	7	Grade Jersey, Holstein, . .	Pasture (Nov.), hay, corn stover,	2 qts. bran, . .	4 qts. cob meal and bran, .	5	–	–
63	6	6	31	27	5.17	4.50	5	Grade Jersey, ...	Pasture (Nov.), rowen, hay, .	4 qts. bran, . .	Same, ...	–	6	–
64	11	11	30	28	2.73	2.55	5	Pure and grade Jersey, Holstein, Durham, . . .	Hay, corn fodder, . . .	4 qts. meal, . .	Same, ...	4	7	–
65	5	4	31	22	6.20	5.50	5	Grade Jersey, ...	Pasture (Nov.) hay, . . .	2 qts. meal and bran,	Same, ...	4	–	–
66	5	5	25	17	5	3.40	5	Pure and grade Jersey, Holstein,	Pasture (Nov.), hay, . . .	2 qts. meal, . .	Same, ...	1	4	–
67	6	6	22	23	3.67	3.83	7½	Grade Jersey, Holstein, native,	Pasture (Nov.), hay, corn fodder,	1 qt. meal, 3 qts. bran,	1½ qts. meal, 4 qts. bran, .	–	6	–
68	7	7	30	–	4.29	–	5	Grade Holstein and Durham, .	Pasture (Nov.), rowen, corn stover, ...	4 qts. meal and bran,	Same, ...	3	2	2
69	7	7	45	34	6.43	4.86	4½	Grade Jersey and Durham, .	Pasture (Nov.), hay, . . .	4 qts. meal and bran,	Same, ...	2	5	–
70	4	4	9	6	2.25	1.50	6	Grade Jersey, ...	Pasture (Nov.), hay, . . .	None, . . .	None, ...	–	4	–
71	10	10	38	43	3.80	4.30	6	Grade Jersey, native, . .	Pasture (Nov.), hay, corn fodder,	3 qts. meal and bran,	8 qts. meal and bran, . .	5	5	–
72	13	13	44	44	3.38	3.38	5½	Grade Jersey, native, . .	Hay, corn stover, . . .	5 qts. cob meal and shorts, . . .	Same, ...	3	2	6
73	5	5	13	23	2.60	4.60	6	Grade Jersey, ...	Pasture (Nov.), hay, corn stover,	4 qts. meal and bran,	Same, ...	4	1	–
74	3	3	3	7	1	2.33	2½	Grade Jersey, Durham, Devon,	Pasture (Nov.), hay, corn fodder,	None, . . .	Bran, ...	3	–	–
75	14	–	53	48	3.79	–	5	Grade Jersey, ...	Hay, ...	8 qts. meal and bran,	Same, ...	–	–	–
76	4	4	12	12	3	3	2	High-grade Jersey, grade Durham, ...	Hay, ...	6 qts. bran, bakery waste, . . .	Same, ...	–	–	–
77	6	6	26	24	4.33	4	6	Grade Jersey, native, . .	Hay, rowen, corn fodder, . .	4 qts. bran, 2 qts. meal,	Same, ...	–	–	–

* Sells milk.

Details of Farms contributing to Creamery A — Continued.

FARM NUMBER.	NUMBER OF COWS.		SPACES OF CREAM.		SPACES PER COW.		Average Age of Cows.	BREED.	COARSE FEED.	GRAIN FEED.		NUMBER OF MONTHS SINCE LAST CALF.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
78	12	12	28	27	2.33	2.25	4	Pure and grade Jersey, . .	Pasture (Nov.), hay, corn stover,	None, . . .	None, ...	–	–	–
79	12	12	4*	–*	.33	–	4	Grade Jersey, ...	Pasture (Nov.), hay, corn stover,	4 qts. bran and meal,	Same, ...	–	–	–
80	7	6	14	17	2	2.83	8	Grade Jersey, ...	Hay, ...	2 qts. bran, . .	Same, ...	–	–	7
81	6	6	11	13	1.83	2.17	5	Grade Jersey and Durham, .	Hay, corn stover, . . .	None, . . .	2 qts. fine feed, . . .	1	4	1
82	4	4	31	26	7.75	6.50	6	Pure Jersey, ...	Hay, ...	6 qts. meal and bran,	Same, ...	4	–	–
83	6	6	26	24	4.33	4	7	Grade Jersey, native, . .	Hay, corn fodder, . . .	5 qts. bran, 2 qts. meal,	Same, ...	2	4	–
84	7	7	20	16	2.86	2.29	6	Grade Jersey, Durham, . .	Pasture (Nov.), hay, corn fodder,	2 qts. meal, . .	Same, ...	–	–	–
85	8	8	24	25	3	3.13	5	Grade Jersey, Durham, . .	Hay, corn fodder, . . .	1 qt. meal and bran, .	Same, ...	1	4	3
86	5	5	20	20	5	5	6½	Pure and grade Jersey, grade Guernsey, ...	Hay, corn stover, . . .	6 qts. meal and bran,	Same, ...	–	5	–
87	7	7	13	–	1.86	–	5	Grade Jersey, ...	Hay, corn fodder, . . .	3 qts. meal and bran,	Same, ...	2	4	–
88	8	8	21	13	2.63	1.63	5	Native, ...	Hay, corn fodder, . . .	4 qts. bran, 2 qts. meal, . . .	Same, ...	3	5	-
89	6	6	19	16	3.17	2.67	6	Native, ...	Pasture (Nov.), hay, corn fodder,	4 qts. bran, . .	4 qts. bran, 2 qts. meal, .	1	4	1
90	7	3	7	13	2.43	4.33	4½	Grade Jersey, ...	Hay, rowen, corn fodder, . .	4 qts. bran, rye, corn,	Same, ...	2	1	–
91	8	8	27	16	3.38	2	7	Grade Jersey, native, . .	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same, ...	–	4	4

92	12	12	41	31	3.42	2.58	6	Grade Jersey, Durham, Holstein, native,	Pasture (Nov.), rowen, corn stover,	2 qts. meal and bran,	Same,	2	5	5
93	5	5	13	13	2.60	2.60	6	Native,	Pasture (Nov.), rowen, corn stover,	None,	None,	–	4	1
94	18	18	80	71	4.44	3.94	6	Grade Jersey, native,	Hay, corn fodder,	Meal and bran,	Same,	–	–	–
95	7	7	26	20	3.71	2.86	6	Grade Jersey,	Pasture (Nov.), oats, hay, corn fodder,	None,	3 qts. cob meal and oats,	1	3	3
96	5	5	23	18	4.60	3.60	5	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	2 qts. bran,	4 qts. meal and bran,	–	5	–
97	2	–	6	–*	3	–	4½	High-grade Jersey,	Pasture (Nov.), hay,	5 qts., ⅓ rye, ⅔ corn,	4 qts. corn and rye,	10	2	–
98	12	12	55	50	4.58	4.17	6	Grade Jersey and Durham,	Pasture (Nov.), hay,	2 qts. meal, 4 qts. bran,	Same,	–	12	–
99	11	11	54	46	4.91	4.18	6	Grade Jersey, Durham,	Soft corn (Nov.), corn fodder, rowen, hay,	None,	4 qts. corn and oats,	3	1	7
100	12	12	45	49	3.75	4.08	4	Grade Durham, Holstein, Hereford, Devon,	Pasture (Nov.), hay, corn fodder,	3 qts. bran,	Same,	2	10	–
101	13	14	77	70	5.92	5	7	Grade Jersey,	Rowen, hay, corn fodder,	4 qts. meal and bran,	3 qts. meal, 2 qts. shorts,	7	6	1
102	7	9	31	35	4.43	3.89	7	Grade Jersey, Guernsey, Holstein, native,	Hay, corn fodder,	8 qts. meal, bran, middlings,	4 qts. meal and middlings,	5	4	–
103	5	5	25	23	5	4.60	4½	Grade Jersey, native,	Hay, corn fodder,	None,	1 qt. meal,	2	3	–
104	10	10	42	56	4.20	5.60	3½	Grade and pure Guernsey,	Hay,	4 qts. meal and middlings,	Same,	1	6	3
105	8	8	36	31	4.50	3.88	6½	Pure and grade Jersey,	Hay, corn stover,	3 qts. meal,	Same,	–	–	8
106	2	6	9	19	4.50	3.17	7½	Pure Jersey and Hereford,	Hay, corn fodder,	8 qts. meal and bran,	Same,	–	6	–
107	7	–	26	36	3.71	–	5	Grade Jersey, Durham,	Hay, corn fodder,	2 qts. meal and bran,	Same,	–	–	–
108	5	5	19	20	3.80	4	5	Grade Durham,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	2	–
109	4	4	16	15	4	3.75	5	Pure and grade Jersey,	Hay, corn fodder,	Meal,	Same,	2	2	–

* Sells milk.

Details of Farms contributing to Creamery A — Concluded.

FARM NUMBER.	NUMBER OF COWS.		SPACES OF CREAM.		SPACES PER COW.		Average Age of Cows.	BREED.	COARSE FEED.	GRAIN FEED.		NUMBER OF MONTHS SINCE LAST CALF.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
110	9	9	21	31	2.33	3.44	5½	Grade Jersey, Holstein, native,	Hay, corn stover,	4 qts. meal and bran,	Same,	1	8	–
111	6	12	17	30	2.83	2.50	6	Grade Durham,	Hay, corn stover,	Meal and bran,	Same,	–	11	1
112	11	11	26	31	2.36	2.82	6	Grade Jersey, native,	Hay, corn stover,	6 qts. meal, bran, oats,	Same,	–	11	–
113	10	10	27	55	2.70	5.50	3½	Grade Jersey, Ayrshire,	Pasture (Nov.), hay,	None,	None,	1	9	–
114	4	4	13	10	3.25	2.50	5	Grade Jersey, native,	Hay,	4 qts. meal,	Same,	–	4	–
115	5	6	24	32	4.80	5.33	5½	Grade Jersey, Durham,	Rowen, corn stover,	4 qts. meal and bran,	Same,	2	4	–
116	2	2	10	14	5	7	5	Grade Jersey, Ayrshire, native,	Rowen, hay, corn stover,	4 qts. cob meal,	Same,	1	1	–
117	4	4	18	20	4.50	5	5	Grade Jersey, Durham,	Hay, corn stover,	5½ qts. meal and bran,	7 qts. meal and bran,	1	3	–
118	6	6	24	20	4	3.33	4½	Grade Jersey, Holstein, native,	Hay,	3 qts. corn and rye,	Same,	2	4	–
119	13	13	48	40	3.69	3.08	5½	Grade Jersey, Ayrshire,	Hay, corn fodder,	8 qts. meal and middlings,	Same,	2	11	–
120	10	–	51	57	5.10	–	4	Grade Jersey,	Hay, corn fodder,	6 qts. meal and bran,	Same,	4	6	–
121	13	13	23	29	1.77	2.23	5	Grade Durham, Guernsey, pure Holstein,	Pasture (Nov.), hay, corn fodder,	4½ qts. meal and bran,	Same,	3	6	4
122	7	10	31	48	4.43	4.80	6	Grade Jersey, Ayrshire,	Pasture (Nov.), hay, corn stover,	3 qts. meal and bran,	4½ qts. cob meal, bran, rye,	4	2	4
123	8	8	19	10	2.38	1.25	7	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	4 qts. meal,	Same,	–	8	–

124	6	6	14	23	2.33	3.83	5	Pure and grade Jersey, grade Durham, Ayrshire,	Rowen, corn fodder,	None,	4 qts. cob meal,	2	4	–
125	13	20	52	48	4	2.40	5½	Grade Holstein, native,	Hay, corn stover,	6 qts. meal and bran,	3 qts. cob meal,	–	20	–
126	4	4	13	14	3.25	3.50	4½	Native,	Hay, corn stover,	1 qt. meal,	Same,	1	2	1
127	5	5	22	18	4.40	3.60	5	Grade Jersey,	Hay, corn fodder,	4 qts. meal and bran,	Same,	1	3	1
128	19	19	63	58	3.33	3.06	6	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	4 qts. bran,	Same,	3	10	5
129	7	7	27	23	3.85	3.29	6	Grade Jersey, Durham,	Rowen, corn fodder,	4 qts. meal,	Same,	3	2	2
130	–	6	–	43	–	7.17	5	Grade Jersey, Holstein,	Hay, corn fodder,	– –	4 qts. cob meal, 6 qts. bran,	5	1	–
131	–	4	–	11	–	2.75	6	Grade Jersey,	Hay,	– –	2 qts. cob meal and bran,	3	1	–

Details of Farms contributing to Creamery B.

Farm Number.	Number of Cows.		Spaces of Cream.		Spaces per Cow.		Average Age of Cows.	Breed.	Coarse Feed.	Grain Feed.		Number of Months since Last Calf.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
1	3	3	13	12	3.33	4	5	Grade Jersey,	Rowen, oat straw,	6 qts. meal and bran,	Same,	1	2	–
2	4	4	9	10	2.25	2.50	4	Grade Jersey, Durham, native,	Rowen, hay,	None,	None,	–	–	4
3	6	6	17	14	2.83	2.33	8½	Grade Holstein, native,	Pasture (Nov.), rowen,	None,	None,	–	3	3
4	14	6	32	22	2.29	3.67	6	Grade Jersey, Durham, Holstein,	Hay, corn fodder,	2 qts. meal, 4 qts. bran,	Same,	2	6	6
5	8	7	20	21	2.50	3	5½	Grade Jersey,	Pasture (Nov.), rowen, corn stover,	None,	None,	–	6	2
6	11	12	58	47	5.27	3.91	6½	Grade Jersey,	Pasture (Nov.) hay,	4 qts. bran,	4 qts. meal and bran,	2	3	3
7	9	9	40	43	4.44	4.77	8	Grade Jersey, Durham, Hereford,	Pasture (Nov.), hay, oats, corn stover,	Meal and bran,	2 qts. meal and bran,	–	5	4
8	11	11	34	32	3.09	2.90	7	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	None,	6 qts. meal and bran,	–	4	7
9	5	8	7	22	1.40	2.75	5½	Pure and grade Jersey, grade Durham,	Pasture (Nov.), hay, potatoes (Nov.),	4 qts. bran,	4 qts. meal and bran,	1	5	2
10	6	6	32	24	5.16	4	4	Grade Jersey, Durham,	Pasture (Nov.), hay, rowen,	None,	2 qts. meal and bran,	1	3	2
11	4	4	13	9	3.25	2.25	5	Grade Jersey, Ayrshire,	Pasture (Nov.), hay,	None,	2 qts. meal,	1	2	1

12	5	4	8	7	1.60	1.75	5	Natives,	Hay, corn fodder,	None,	None,	1	2	1
13	13	12	37	43	2.85	3.58	6	Grade Jersey, native,	Hay, corn fodder,	2 qts. cob meal,	4 qts. cob meal,	2	5	5
14	8	9	41	40	5.12	4.44	6½	Pure and grade Jersey, pure Durham, natives,	Rowen, hay, soft corn,	8 qts. meal and bran,	Same,	3	4	2
15	6	6	20	23	3.33	3.83	6	Grade Jersey,	Hay,	3 qts. meal and bran,	Same,	2	3	1
16	4	4	22	21	5.50	5.25	6	Pure and grade Jersey,	Oats and straw, hay,	Meal and bran,	Same,	3	1	–
17	3	3	19	17	6.33	5.67	4	Pure Jersey and grades,	Rowen,	6 qts. meal and bran,	Same,	–	3	–
18	11	11	39	34	3.54	3.09	6½	Grade Jersey, native,	Pasture (Nov.), hay,	None,	4 qts. meal and bran,	2	8	1
19	14	15	67	65	4.79	4.33	6	Grade Jersey, Durham, native,	Pasture (Nov.), hay, rowen, corn stover,	4 qts. ⅔ meal, ⅓ bran,	6 qts. ⅔ meal ⅓ bran,	13	1	–
20	4	6	18	18	4.50	3	6	Grade Jersey, native,	Pasture (Nov.), hay, corn stover, rowen,	None,	1½ qts. meal and rye,	2	2	–
21	22	16	61	33*	2.69	2.06	5	Grade Jersey,	Hay, corn fodder (Dec.),	4 qts. meal and bran,	Same,	5	9	2
22	6	7	19	26	3.16	3.71	6	Pure and grade Jersey,	Hay, corn fodder,	4 qts. meal and bran,	Same,	3	4	–
23	5	4	18	14	3.60	3.50	3	Grade Jersey, Holstein, native,	Hay, rowen, corn fodder,	1 qt. meal, 2 qts. bran,	Same,	1	3	–
24	6	3	10	12	1.66	4	5	Grade Jersey,	Pasture (Nov.), hay, corn stover,	4 qts. meal and bran,	Same,	–	2	1
25	17	16	72	74*	4.18	4.62	6	Grade Jersey, Devon,	Rowen, hay, barley, corn stover,	3 qts. meal, 2 qts. bran,	Same,	6	8	2
26	4	5	19	22	4.75	4.40	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn stover,	None,	4 qts. cob meal and bran,	4	–	–
27	8	6	21	24	2.62	4	5	Grade Jersey,	Pasture (Nov.), rowen, corn stover,	None,	2 qts. corn and rye,	5	1	–
28	10	8	35	31	3.50	3.87	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	3 qts. bran,	3 qts. meal and bran,	–	4	6
29	12	12	26	43	2.17	3.58	4	Grade Jersey, Holstein, Durham,	Pasture (Nov.), hay, corn fodder,	None,	3 qts. meal and bran,	–	5	7
30	13	10	42	31	3.23	3.10	5½	Grade Holstein,	Hay, corn fodder,	2 qts. cob meal,	4 qts. meal and bran,	–	5	5
31	4	4	11	21	2.75	5.25	4	Grade Jersey,	Hay, corn fodder,	2 qts. meal and bran,	Same,	2	2	–

* Sells milk.

Details of Farms contributing to Creamery B — Concluded.

FARM NUMBER.	NUMBER OF COWS.		SPACES OF CREAM.		SPACES PER COW.		Average Age of Cows.	BREED.	COARSE FEED.	GRAIN FEED.		NUMBER OF MONTHS SINCE LAST CALF.		
	November.	December.	November.	December.	November.	December.				November.	December.	Less than 3 mos.	3 mos. to 9 mos.	More than 9 mos.
32	7	7	31	22	4.43	3.14	6	Grade Jersey, Ayrshire,	Hay,	1½ qts. meal,	Same,	–	–	–
33	4	3	14	14	3.50	4.66	5½	Pure and grade Jersey,	Pasture (Nov.), hay,	1 qt. meal,	3 qts. meal,	3	1	–
34	2	4	15	26	7.50	6.50	6	Grade Durham,	Hay, corn stover,	None,	Corn,	3	1	–
35	2	2	9	7	4.50	3.50	5	Grade Jersey,	Hay,	Bran,	2 qts. meal, 1 qt. bran,	–	2	–
36	20	–	98	42	4.90	–	8	Grade and pure Jersey, Durham, Holstein,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	–	–	–
37	18	20	72	82	4	4.10	6	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	4 qts. meal and bran,	Same,	15	3	2
38	7	8	24	34	3.43	4.25	6	Grade Holstein, Durham, native,	Pasture (Nov.), rowen, corn fodder,	8 qts. cob meal and bran,	Same,	2	6	–
39	14	14	42	45	3.00	3.21	5	Native,	Hay, corn fodder,	6 qts. meal and bran,	Same,	–	8	6
40	7	8	23	23	3.28	2.87	7	Grade Holstein, Jersey, Durham,	Pasture (Nov.), rowen,	None,	5 qts. cob meal and bran,	2	6	–
41	13	13	46	52	3.53	4	7	Grade Jersey, native,	Pasture (Nov.), hay, corn fodder,	6 qts. meal and bran,	Same,	1	12	–
42	9	9	21	32	2.33	3.44	6	Pure and grade Jersey,	Pasture (Nov.), rowen, corn fodder,	4 qts. bran,	Same,	3	5	1
43	7	7	18	18	2.57	2.57	5	Grade Jersey, Durham,	Pasture (Nov.), hay, corn stover,	None,	8 qts. meal and bran,	–	7	–
44	8	9	11	26	1.37	2.88	7	Grade Jersey, Holstein,	Hay,	Bran,	6 lbs. meal and bran,	5	2	2

45	7	7	16	20	2.28	2.85	6½	Grade Jersey, native,	Hay, corn stover,	None,	2 qts. meal,	1	3	3
46	6	6	18	14	3	2.33	6	Grade Jersey,	Hay, corn fodder,	7 qts. meal and bran,	Same,	2	1	3
47	7	7	14	24	2	3.42	6	Grade Durham, native,	Pasture (Nov.), hay, corn stover,	4 qts. bran,	4 qts. cob meal,	3	3	1
48	7	7	28	25	4	3.57	4½	Grade Jersey, Holstein,	Hay, corn fodder,	Meal and bran,	4 qts. meal and bran,	3	4	–
49	5	5	28	24	5.60	4.80	6½	Pure Jersey, grade Durham, Devon, Ayrshire,	Pasture (Nov.), hay, corn fodder,	1 qt. meal, 2 qts. bran,	Same,	2	–	3
50	9	9	29	35	3.22	3.88	7	Grade Jersey, Holstein, Durham,	Hay,	6 qts. bran,	Same,	2	3	4
51	8	8	26	–	3.25	–	6	Grade Jersey, Durham, Guernsey, Devon, Ayrshire,	Grass (Nov.), hay,	3 qts. meal,	Same,	–	–	–
52	7	7	21	15	3	2.14	6	Grade Jersey, Ayrshire,	Hay, corn fodder,	Corn, oats, bran,	Same,	–	–	–
53	5	6	20	19	4	3.16	4½	Grade Jersey, Guernsey, native,	Hay, corn stover,	6 qts. meal and bran,	Same,	3	3	–
54	4	4	13	8	3.25	2	5½	Grade Jersey, Guernsey, Durham, Ayrshire,	Hay,	None,	None,	–	2	2
55	2	3	10	7	5	2.33	4½	Grade Jersey, native,	Hay, corn fodder, pumpkins (Nov.),	None,	Cob meal,	–	2	1
56	3	2	11	4	3.67	2	4½	Grade Jersey, Durham,	Pasture (Nov.), hay, corn fodder,	None,	3 qts. meal,	–	3	–
57	11	11	35	24	3.18	2.18	6½	Grade Jersey, Ayrshire,	Hay, oats, corn fodder,	4 qts. meal and bran,	Same,	–	11	–
58	6	6	10	–	1.67	–	4	Grade Jersey,	Pasture (Nov.), hay, corn fodder,	None,	–	–	–	–
59	14	14	37	22	2.64	1.57	6½	Grade Jersey, Holstein,	Hay, oats, corn fodder,	None,	2 qts. meal,	2	6	3
60	3	3	12	20	4	6.67	6	Grade Durham,	Pasture (Nov.), hay,	8 qts. meal and bran,	Same,	2	1	–
61	5	4	16	13	3.20	3.25	4½	Grade Jersey,	Pasture (Nov.), hay, corn fodder, pumpkins (Nov.),	Meal and bran,	4 qts. meal and middlings,	–	4	–
62	–	6	–	41	–	6.83	5	Grade Jersey,	Hay,	–	3 qts. meal,	4	1	1

Summary.

	Creamery A.	Creamery B.
Number of farms contributing,	131,	62
Total spaces of cream Nov. (1 day),	3,671,	1,668
Total spaces of cream Dec. (1 day),	3,470,	1,593
Total number of cows Nov. (1 day),	1,013,	483
Total number of cows Dec. (1 day),	1,033,	456
Lowest space per cow,*	1 (Farm Nos. 61 and 74),	1.40 (Farm No. 9).
Highest space per cow,	7.75 (Farm No. 82),	7.50 (Farm No. 34).
Average spaces per cow,	3.49,	3.42
Average age of cows,	5¾ years,	5½ years.
Average space per cow in station dairy, 5.25.		

* Excluding cases where milk is sold.

V. Feeding Experiments with Pigs.

The preceding annual report contains a summary of a series of feeding experiments with pigs, carried on at this station since 1884, for the purpose of ascertaining the cost of the feed required to produce a given quantity of dressed pork. Our first attention in this connection was directed towards a profitable disposition of two by-products of the dairy industry, — skim-milk and buttermilk from creameries. As the daily supply of these materials varies, for obvious reasons, widely on farms, it seemed advisable to devise economical fodder rations adapted to different conditions in that direction.

The daily diet in our earlier experiments contained a more liberal amount of milk than in our later ones. For several years past we have raised, the whole year around, for every cow on our farm, a pig for the meat market, to dispose of our skim-milk. This course necessitated, at times, additional resources of supply of nutritious food. To meet this requirement in an economical and profitable way, and by means which are in the reach of every farmer, has been our aim. How we have thus far succeeded in our endeavor, may be ascertained from a subsequent short review of our previous course of observation. A correct interpretation of our latest feeding experiment (X.), which forms the principal part of the subsequent communication, renders a brief restatement of the results of our earlier experiments advisable.

During our first and second experiments (1884), skim-milk or buttermilk or both and corn meal furnished the daily feed. In the first experiment, the relative proportions of skim-milk or of buttermilk and of corn meal remained the same from the beginning to the end of the trial; namely, three ounces of corn meal for every quart of skim-milk required to meet the increasing wants of the animals. The daily average consumption per head amounted at the close of the experiment to fourteen quarts of skim-milk and forty-two ounces of corn meal. The nutritive character of the daily diet remained practically the same during most of the time of observation. It was, in the case of the buttermilk diet, one part of digestible nitrogenous food constituents to from 2.84 to 3.38 parts of non-nitrogenous food constituents; and in case of that of the skim-milk, one of the former to from 2.50 to 2.90 of the latter; the variations being mainly due to the difference in the amount of solid matter in the two kinds of milk.

In the second feeding experiment (1885), the relative proportion between skim-milk or buttermilk and corn meal was different from that in the first one. During the first period of the second experiment, only two ounces of corn meal were added to each quart of milk required to satisfy the animal. As soon, however, as from six to seven quarts per head were consumed daily, four ounces of corn meal were fed for every quart of milk. Another increase in corn meal was made when ten quarts of milk were called for; and again, when twelve quarts were consumed per head. The experiment closed with a daily average ration per head of from ten to twelve quarts of milk, and from eighty to ninety-six ounces of corn meal. In consequence of this course of feeding, the nutritive character of the daily diet was changed from time to time. The periodical increase of corn meal in the daily fodder rations caused the introduction of a larger proportion of non-nitrogenous food constituents, as starch, sugar, fat, etc., in the diet, than of nitrogenous constituents. The experiment began with a diet which contained one part of digestible nitrogenous constituents to 2.7 of non-nitrogenous food constituents, and closed with 1 : 5 in case of skim-milk and 1 : 4.5 in case of buttermilk.

The expiration of a contract with a creamery in our vicinity deprived us, at that stage of our investigation, of a liberal supply of buttermilk. A limited supply of home-made skim-milk necessitated a modification of our feeding system, in case that at least six pigs should be engaged in the experiments at one time. It was therefore decided to feed the skim-milk from our herd of six cows, in equal quantities, to six growing pigs, and to supply the additional feed from other suitable sources, including corn meal in part. It seemed also of interest to learn whether the particular course pursued in the previously described experiments of feeding skim-milk from the home dairy with corn meal alone could be improved on; and, if so, in what direction. Gluten meal and wheat bran were chosen, for various reasons, to serve in connection with corn meal to furnish the additional ingredients of the diet, as soon as our milk supply became exhausted. This course promised to serve two distinct purposes: —

1. The rich nitrogenous character of gluten meal and of wheat bran offered a chance to secure any desired change in the nutritive character of the feed, as far as the relative proportion of the digestible nitrogenous and non-nitrogenous food constituents are concerned; and

2. To reduce the net cost of the feed, in case they proved to be an efficient substitute for larger quantities of corn meal, on account of the larger quantities of certain essential fertilizing constituents they contain.

The statement that an addition of gluten meal or of wheat bran or both, to a diet which previously consisted only of skim-milk and corn meal, tends to increase the commercial value of the manurial refuse resulting, is based on the following considerations: —

1. The principal fertilizing elements contained in a mixture of equal parts of gluten meal and wheat bran have a higher market value than those contained in an equal weight of corn meal.

2. It is admissible, for mere practical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, a corresponding amount of nitrogen, of phosphoric acid, of potassium oxide, etc., will be retained and stored up in the growing animal.

An excess, therefore, of any or of all of the three essential fertilizing constituents previously specified, in one diet, as compared with that of another one, counts in favor of that particular diet as far as net cost of feed is concerned. Although it must be acknowledged that, even in one and the same feeding experiment, most likely no two animals would show strictly corresponding relations in that direction, it remains not less true that it is a most commendable practice, in a general farm management, to consider carefully the relative value of the fertilizing constituents contained in the various fodder articles which present themselves for our choice in the compounding of suitable fodder rations. Our allowance of a loss of thirty per cent. of the essential fertilizing constituents contained in the food consumed, in consequence of the development and growth of the animal, is purposely a liberal one. The adoption of this basis for our estimate tends to strengthen our conclusion that the raising of pigs for the home market can be made a profitable branch of farm industry, even with comparatively limited resources of skim-milk.

The daily supply of skim-milk has not exceeded, at any period, eight quarts of milk during our later experiments, from the third to the ninth inclusive; most of the time it has been from four to five quarts per head. The relative proportion of corn meal, wheat bran and gluten meal has been frequently altered in case of different experiments, as well as at different stages of the same experiment, with varying results. The ninth experiment, which has been described in detail in our sixth annual report, has been, from an economical stand-point, thus far the most successful one. A brief abstract of that experiment may here suffice to show our late mode of compounding fodder rations for pigs at different stages of growth, in connection with the financial results we secured.

The summary includes our entire series of pig feeding described in previous reports, and also the last one, the tenth, which is for the first time published in detail in some succeeding pages.

Average of Daily Rations (Experiment IX.).

	Corn Meal (Ounces).	Skim-milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Corn and Cob Meal (Ounces).	Feeding Periods.	Nutritive Ratio of Food.
1888.							
April 12 to April 23, .	–	3	–	–	6.	I.	1 : 2.80
April 24 to May 1, .	–	6	–	–	12.		
May 2 to May 14, .	–	6	3.47	6.94	12.	II.	1 : 2.53
May 15 to May 28, .	–	6	9.89	19 78	12.		
May 29 to June 4, .	–	6	10.67	21.34	12.		
June 5 to June 22, .	–	6	8.65	8.65	34.60	III.	1 : 3.63
June 23 to July 3, .	–	6	9.86	9.86	39.44		
July 4 to July 9, .	–	6	7.70	7.70	46.20	IV.	1 : 4 35
July 10 to July 25, .	56.10	6	9.35	9.35	–		
July 26 to Aug. 8, .	63.00	6	10.50	10.50	–		

Experiment IX.	Live Weight of Animal.	Nutritive Ratio.
Period I,	20 to 90 pounds,	One digestible nitrogenous, 2.66 digestible non-nitrogenous, constituents
Period II.,	90 to 130 pounds,	One digestible nitrogenous, 3.62 digestible non-nitrogenous, constituents.
Period III.,	130 to 200 pounds,	One digestible nitrogenous, 4.35 digestible non-nitrogenous, constituents.

The calculations included in the following summary were based upon the following valuations per ton: —

	Cost.	Manurial Value.
Corn meal,	$24 00	$7 97
Barley meal,	30 00	6 21
Skim-milk (10 per cent. solids),	1.8 cts. gal.	2 25
Buttermilk (7 to 8 per cent. solids),	1.37 " "	1 74
Corn and cob meal,	$20 70	6 06
Wheat bran,	22 50	13 51
Gluten meal,	22 50	17 49

Summary of Experiments I. to X.

[Based on the same cost of feed and value of manurial refuse.]

EXPERIMENT.		Number of Pigs.	Average Weight of Pigs at Beginning of Experiment (Pounds).	Average Weight of Pigs at Close of Experiment (Pounds).	Articles of Fodder used.	Nutritive Ratio of Feed.	Pounds of Dry Matter consumed for the Production of One Pound of Dressed Pork.	Total Cost of Feed per Pound of Dressed Pork (Cents).	Manurial Value of Feed per Pound of Dressed Pork, after deducting Thirty Per Cent. taken by Pig (Cents).	Net Cost of Feed per Pound of Dressed Pork (Cents).
I. May 21 to Sept. 22, 1884,	*a*,	3	48.8	239.0	Skim-milk, corn meal, .	1 : 2.50 to 1 : 2.97	2.50 to 3.11; average 2.90	5.15	1.70	3.45
	b,	3	47.6	253.9	Buttermilk, corn meal, .	1 : 2.84 to 1 : 3.38	2.23 to 2.57; " 2.40	4.30	1.38	2 92
II. Nov. 5, 1884, to Mar. 21, 1885,	*a*,	6	30.1	209.7	Buttermilk, corn meal, .	1 : 3.5 to 1 : 4.8	3.34 to 4.17; " 3.67	5.91	1.80	4.11
	b,	6	28.7	227.0	Skim milk, corn meal, .	1 : 2.7 to 1 : 5.00	2.97 to 3.48; " 3.31	5.51.	1.69	3.82
III. April 1 to Sept. 16, 1885, . .		2	49.8	276.3	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 3.04 to 1 : 3.76	4.01 to 4.18; " 4.10	6.41	2.01	4.40
IV. Dec. 8, 1885, to May 31, 1886, .		2	32.9	152.4	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 2.64 to 1 : 4 48	3.77 to 4.08; " 3.93	6.33	2.13	4.20
V. Sept. 15, 1886, to Jan. 19, 1887, .		4	32.6	175.0	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 2.75 to 1 : 3.57	3.56 to 4.31; " 3.92	5.40	2.02	3.38
VI. Feb. 17 to May 2, 1887, . . .		5	54.4	152.8	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 2.99 to 1 : 3.23	2.70 to 4.20; " 3.68	5.69	1.95	3.74
VII. June 28 to Oct. 26, 1887, . .		7	24.5	193.3	Skim-milk, corn meal, . Wheat bran, gluten meal,	1 : 2.85 to 1 : 4.30	2.83 to 3.24; " 3 07	5.15	1.76	3.39
VIII. Nov. 8, 1887, to March 12, 1888, .		6	25.2	186.4	Skim-milk, corn meal, . Wheat bran, gluten meal, Corn and cob meal, . .	1 : 2.30 to 1 : 4.17	3.02 to 3.46; " 3.27	5.32	1.74	3.58
IX. April 12 to Aug. 8, 1888, . .		6	19.6	194.7	Skim milk, corn meal, . Wheat bran, gluten meal, Corn and cob meal, . .	1 : 2.53 to 1 : 4.35	2.81 to 3.17; " 3.00	4.89	1.62	3.27
X. April 26 to Aug. 28, 1889, . .		7	20.3	189.9	Skim-milk, barley meal, . Wheat bran, gluten meal,	1 : 2.90 to 1 : 4.65	3.40 to 3.81; " 3.60	6.07	1.75	4.32

Our observations in this connection with the management of the above summarized ten feeding experiments, lead to the following suggestions regarding a proper course of raising pigs for the meat market: —

1. Begin as early as practicable, with a well-regulated system of feeding. During the moderate season, begin when the animals have reached from eighteen to twenty pounds in live weight; in the colder seasons, when they weigh from twenty-five to thirty pounds.

2. The feed for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs, and to make them thereafter good eaters. A liberal supply of skim-milk or buttermilk, with a periodical increase of corn meal, beginning with two ounces of corn meal per quart of milk, has given us highly satisfactory results.

3. Change the character of the diet, at certain stages of growth, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed. Begin, for instance, with two ounces of corn meal to one quart of skim-milk; when the animal has reached from sixty to seventy pounds, use four ounces per quart; and feed six ounces of meal per quart after its live weight amounts to from one hundred and twenty to one hundred and thirty pounds. The superior feeding effect noticed in case of one and the same diet during the earlier stages of growth, will not infrequently be found to decrease seriously during later stages.

4. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from one hundred and seventy-five to one hundred and eighty pounds is only advisable when exceptionally high market prices for dressed pork can be secured. The quality of the meat is also apt to be impaired by an increased deposition of fat. The power of assimilating food and of converting it in an economical way into an increase of live weight, decreases with the progress of age.

5. It pays well, as far as the cost of feed is concerned, to protect the animals against the extremes of the season. Feeding experiments carried on during moderate seasons are more profitable than those carried on, under otherwise corresponding circumstances, during the winter season.

Weights taken at Time of killing of Pigs fattened at the Experiment Station (in Pounds).

[Age of pigs when killed, five to eight months.]

NUMBER AND BREED OF PIG.	Live Weight.	Dressed Weight.	Per Cent. of Live Weight lost by Dressing.	Heart.	Lungs.	Liver.	Heart, Lungs and Liver.	Stomach (empty).	Intestinal Fat.
1. Yorkshire — Berkshire,	231.25	194.50	15.89	–	–	–	4.25	1.25	4.50
2. " "	247.00	203.75	17.50	–	–	–	6.00	1.50	5.00
3. " "	218.50	183.25	16.13	–	–	–	4.50	1.25	5.00
4. Yorkshire — White Chester,	165.00	132.75	19.50	–	–	–	4.25	1.25	3.75
5. " " "	197.75	161.50	18.35	–	–	–	5.00	1.50	4.00
6. " " "	198.50	159.50	19.64	–	–	–	5.25	1.25	5.00
7. Yorkshire — Berkshire,	253.25	208.50	17.67	–	–	–	5.75	1.25	6.00
8. " "	243.25	205.25	15.60	–	–	–	5.25	1.50	4.00
9. " "	249.25	209.25	16.00	–	–	–	6.00	1.75	6.00
10. Yorkshire — White Chester,	209.00	168.50	19.40	–	–	–	6.00	1.50	4.50
11. " " "	191.00	158.50	17.02	–	–	–	5.50	1.25	5.25
12. " " "	216.25	173.50	19.77	–	–	–	5.50	1.25	6.00
13. Mixed,	196.00	167.50	14.54	–	–	–	4.25	1.25	1.75
14. "	306.00	258.00	15.69	–	–	–	6.50	1.50	5.50
15. "	178.50	150.50	15.69	–	–	–	3.75	1.00	2.50
16. "	246.50	210.00	14.81	–	–	–	5.00	1.25	4.75
17. "	164.00	137.00	16.46	.50	.75	2.25	3.50	–	2.50
18. "	193.25	163.00	15.65	.50	.75	2.75	4.00	–	2.25
19. "	178.25	153.00	14.16	.33	1.25	2.00	3.58	–	1.75
20. Berkshire — White Chester,	204.00	162.00	20.59	.63	1.25	3.75	5.63	–	2.38
21. " " "	184.00	145.00	21.20	.50	1.06	3.25	4.81	–	2.19
22. " " "	201.00	156.00	22.39	.50	1.21	3.75	5.46	–	3.38

23. Berkshire — White Chester,	193.00	158.00	18.13	.56	1.44	3.00	5.00	–	2.63
24. " " "	197.00	156.00	20.81	.53	1.13	3.75	5.41	–	2.88
25. " " "	184.50	144.00	21.95	.44	0.81	3.75	5.00	–	3.25
26. " " "	189.50	148.00	21.90	.50	1.00	3.75	5.25	–	3.13
27. Mixed,	189.00	154.00	18.52	.56	1.32	3.32	5.20	–	2.50
28. "	198.00	160.00	19.19	.50	1.50	3.00	5.00	–	3.81
29. "	187.00	151.00	19.25	.50	1.50	3.06	5.06	–	2.44
30. "	181.50	150.00	17.31	.44	1.19	3.44	5.07	–	2.50
31. "	184.50	150.00	18.70	.44	1.38	3.32	5.14	–	3.00
32. "	200.75	162.00	19.30	.69	1.56	3.63	5.88	–	3.38
33. "	185.75	152.00	18.17	.56	1.56	2.63	4.75	–	1.88
34. "	190.25	158.00	16.93	.50	1.13	3.00	4.63	–	2.69
35. "	188.75	154.00	18.15	.75	1.19	2.38	4.32	–	2.38
36. "	193.75	158.00	18.45	.75	1.75	2.88	5.38	–	2.25
37. "	203.50	168.50	17.20	.50	1.25	3.19	4.94	–	1.88
38. White Chester,	183.75	154.00	16.19	.25	1.50	2.13	3.88	1.00	2.25
39. " "	194.25	162.00	16.61	.25	1.38	2.63	4.26	1.13	3.38
40. Mixed,	207.50	172.50	16.87	.38	1.50	2.25	4.13	0.88	3.75
41. "	211.50	177.00	16.31	.38	1.25	2.50	4.13	0.88	3.63
42. Grade White Chester,	185.00	153.50	17.03	.50	0.94	4.00	5.44	1.19	1.94
43. " " "	199.00	163.00	18.09	.37	1.31	3.31	4.99	–	1.63
44. " " "	188.50	151.00	19.89	.44	1.13	3.56	5.13	1.25	1.94
45. " " "	200.00	162.00	19.00	.63	1.44	4.13	6.20	1.38	1.88
46. Mixed,	182.00	145.50	20.05	.56	1.50	3.69	5.75	1.50	2.81
47. "	177.00	141.00	20.34	.44	0.88	3.13	4.45	1.56	3.00
48. "	197.50	159.00	19.49	.53	1.38	3.50	5.41	1.50	1.50

Summary.

	Average Weight (Pounds).	Number of Pigs, averaged.
Live weight,	201.23	48
Dressed weight,	165.11	48
Per cent. of live weight lost by dressing,	17.95	48
Heart,	.50	32
Lungs,	1.26	32
Liver,	3.15	32
Heart, lungs and liver,	4.99	48
Stomach (empty),	1.30	26
Intestinal fat,	3.26	48

The intestinal fat, as may be seen from the preceding statement, varies from 1.75 to 6.00 pounds; its deposition, as a rule, has rapidly increased after the animals pass above 180 to 200 pounds of live weight.

Tenth Feeding Experiment (1889).

[Skim-milk, barley meal, wheat bran and gluten meal.]

The general course pursued in the management of this experiment is essentially the same as that adopted in the preceding ones (VII., VIII. and IX.). The main alteration consists in the circumstance that barley meal has been substituted for corn meal in the daily diet of the animals on trial.

Seven pigs, grades of White Chester and Berkshire, weighing from 14 to 23 pounds each at the beginning, served for our observation. The experiment began April 23, and closed August 28, lasting thus 127 days. The live weight gained during that period varied in case of different animals from 162 to 178¾ pounds. The average live weight gained of the whole lot was 169½ pounds per head, or 1.33 pounds per day. The amount of skim-milk consumed daily per head remained practically the same, after the first week, — five quarts. To every quart of milk required were added two ounces of barley meal. The additional feed subsequently needed consisted of a mixture of two weight parts of gluten meal and one of wheat bran. At the close of the second month of our trial, when the live weights of the various animals amounted to from 120 to 130 pounds each, the diet was changed; a mixture of four weight parts of barley meal and one weight part each of gluten meal and wheat bran was fed with the original quantity of skim-milk, — five quarts daily per head. The subsequent tabular statement shows more in detail the changes in the quantities of the daily fodder rations, and also their nutritive character at different stages of growth. The entire experiment might be divided practically into three feeding periods: —

	Live Weight.	Nutritive Ratio.
Period I., ...	20 to 90 pounds.	1 : 2.95
Period II., ...	90 to 130 pounds.	1 : 4 20
Period III., ...	130 to 200 pounds.	1 : 4.61

Average of Daily Rations (Experiment X.).

	Barley Meal (Ounces).	Skim-milk (Quarts).	Wheat Bran (Ounces).	Gluten Meal (Ounces).	Feeding Periods.	Nutritive Ratio.
1889.						
April 23 to May 1, . .	6.	3.	–	–	I.	1 : 2.90
May 2 to May 13, . .	10.	5.	–	–		
May 14 to May 28, . .	11.	5.5	4.00	8.00	II.	1 : 2.99
May 29 to June 4, . .	10.	5.	7.00	14.00		
June 5 to June 17, . .	10.	5.	11.90	23.80		
June 18 to July 8, . .	37.80	5.	9.47	9.47	III.	1 : 4 12
July 9 to July 22, . .	47.60	5.	11.90	11.90		
July 23 to Aug. 12, . .	58.80	5.	9.80	9.80	IV.	1 : 4.61
Aug. 13 to Aug. 27, . .	64.20	5.	10.70	10.70		

The amount of dry vegetable matter of the feed consumed per pound of dressed pork produced varies in case of different animals from 3.40 to 3.81 pounds, the mean being 3.6 pounds. This result is less favorable than those obtained in our ninth experiment, where the amount of dry vegetable matter consumed per pound of dressed pork obtained was noticed to vary from 2.61 to 3.17 pounds, with an average amount of 2.98 pounds. As both experiments were conducted during the same period of the year, — summer season, — the results apparently point towards a higher nutritive effect of the corn meal, as compared with that of barley meal, under conditions like ours. The final decision in this direction will be left to further trials.

The higher market price of the barley meal, as compared with that of corn meal, at present market rates, is an additional cause of a less favorable financial result than in most of our late experiments, from VI. to IX. inclusive. The average net cost per pound of dressed pork, in our tenth experiment, amounted to 4.29 cents. We received 5¾ cents per pound. For more details, see farther on.

Market Cost of Fodder Articles used.

Barley meal,	$30.00 per ton.	Wheat bran,	$18.50 per ton.
Skim-milk,	1.8 cts. per gal.	Gluten meal,	$22.00 per ton.

Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

[Per cent.]

	Barley Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture,	12.90	89.78	10.92	10.19
Nitrogen,	1.507	.52	2.417	4 230
Phosphoric acid,	.664	.19	2 900	.392
Potassium oxide,	.342	.20	1.637	.049
Valuation per 2,000 pounds,	$6 23	$2 17	$13 27	$14 90

(1)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.	
1889.								lb.	oz.
April 23 to May 13,	11.63	93.00	-	-	1 : 2.90	23.00	41.50		14
May 14 to June 17,	23.62	189.00	18.69	37.38	1 : 2.99	41.50	88.50	1	5
June 18 to July 22,	95.64	175.00	23.91	23.91	1 : 4.17	88.50	135.00	1	5
July 23 to Aug. 28,	133.08	184.00	22.18	22.18	1 : 4.56	135.00	185.00	1	6

Total Amount of Feed consumed from April 23 to August 28.

263.97 pounds barley meal, equal to dry matter,	229.92 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
64.78 pounds wheat bran, equal to dry matter,	57.71 pounds.
83.47 pounds gluten meal, equal to dry matter,	74.96 pounds.
Total amount of dry matter,	504.75 pounds.

Live weight of animal at beginning of experiment,	23.00 pounds.
Live weight of animal at time of killing,	185.00 pounds.
Live weight gained during experiment,	162.00 pounds.
Dressed weight at time of killing,	153.50 pounds.
Loss in weight by dressing,	31.50 pounds, or 17.03 per cent.
Dressed weight gained during experiment,	134.41 pounds.

Cost of Feed consumed during Experiment.

263.97 pounds barley meal, at $30.00 per ton,	$3 96
160.25 gallons skim-milk, at 1.8 cents per gallon,	2 88
64.78 pounds wheat bran, at $18.50 per ton,	60
83.47 pounds gluten meal, at $22.00 per ton,	92
	$8 36

3.12 pounds of dry matter fed yielded 1 pound of live weight, and 3.76 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.22 cents.

(2)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.	
1889.								lb.	oz.
April 23 to May 13,	11.63	93.00	–	–	1 : 2.90	25.25	45.00		15
May 14 to June 17,	23.62	189.00	18.75	37.50	1 : 2.99	45.00	94.00	1	6
June 18 to July 22,	87.36	175.00	21.84	21.84	1 : 4.09	94.00	142.50	1	6
July 23 to Aug. 28,	137.88	184.00	22.98	22.98	1 : 4.60	142.50	199.50	1	8

Total Amount of Feed consumed from April 23 to August 28.

260.49 pounds barley meal, equal to dry matter,	226.89 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
63.57 pounds wheat bran, equal to dry matter,	56.63 pounds.
82.32 pounds gluten meal, equal to dry matter,	73.93 pounds.
Total amount of dry matter,	499.61 pounds.

Live weight of animal at beginning of experiment,	25.25 pounds.
Live weight of animal at time of killing,	199.00 pounds.
Live weight gained during experiment,	173.75 pounds.
Dressed weight at time of killing,	163.00 pounds.
Loss in weight by dressing,	36.00 pounds, or 18.09 per cent.
Dressed weight gained during experiment,	142.32 pounds.

Cost of Feed consumed during Experiment.

260.49 pounds barley meal, at $30.00 per ton,	$3 91
160.25 gallons skim-milk, at 1.8 cents per gallon,	2 88
63.57 pounds wheat bran, at $18.50 per ton,	59
82.32 pounds gluten meal, at $22.00 per ton,	91
	$8 29

2.88 pounds of dry matter fed yielded 1 pound of live weight, and 3.51 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.82 cents.

(3)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.	
1889.								lb.	oz.
April 23 to May 13,	11.63	93.00	–	–	1:2.90	19.75	38.50		14
May 14 to June 17,	23.40	187.00	15.87	31.76	1:2.99	38.50	84.00	1	5
June 18 to July 22,	84.88	175.00	21.22	21.22	1:4.06	84.00	127.50	1	4
July 23 to Aug. 28,	139.60	184.00	23.27	23.27	1:4.61	127.50	188.50	1	10

Total Amount of Feed consumed from April 23 to August 28.

259.51 pounds barley meal, equal to dry matter,	226.03 pounds.
639.00 quarts skim-milk, equal to dry matter,	141.71 pounds.
60.36 pounds wheat bran, equal to dry matter,	53.77 pounds.
76.25 pounds gluten meal, equal to dry matter,	68.48 pounds.
Total amount of dry matter,	489.99 pounds.

Live weight of animal at beginning of experiment,	19.75 pounds.
Live weight of animal at time of killing,	188.50 pounds.
Live weight gained during experiment,	168.75 pounds.
Dressed weight at time of killing,	151.00 pounds.
Loss in weight by dressing,	37.50 pounds, or 19.89 per cent.
Dressed weight gained during experiment,	135.19 pounds.

Cost of Feed consumed during Experiment.

259.51 pounds barley meal, at $30.00 per ton,	$3 89
159.75 gallons skim-milk, at 1.8 cents per gallon,	2 88
60.36 pounds wheat bran, at $18.50 per ton,	56
76.25 pounds gluten meal, at $22.00 per ton,	84
	$8 17

2.90 pounds of dry matter fed yielded 1 pound of live weight, and 3.62 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.04 cents.

(4)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.	
1889.								lb.	oz.
April 23 to May 13,	11.63	93.00	–	–	1 : 2.90	23.00	42.00		14
May 14 to June 17,	23.62	189.00	18.06	36.12	1 : 2.99	42.00	92.00	1	7
June 18 to July 22,	89.64	175.00	22.41	22.41	1 : 4.11	92.00	139 50	1	6
July 23 to Aug. 28,	141.42	184.00	23.57	23.57	1 : 4.62	139.50	200.00	1	10

Total Amount of Feed consumed from April 23 to August 28.

266.31 pounds barley meal, equal to dry matter,	231.96 pounds.
641.00 quarts skim-milk, equal to dry matter,	142.16 pounds.
64.04 pounds wheat bran, equal to dry matter,	57.05 pounds.
82.10 pounds gluten meal, equal to dry matter,	73.73 pounds.
Total amount of dry matter,	504.90 pounds.

Live weight of animal at beginning of experiment,	23.00 pounds.
Live weight of animal at time of killing,	200.00 pounds.
Live weight gained during experiment,	177.00 pounds.
Dressed weight at time of killing,	162.00 pounds.
Loss in weight by dressing,	38.00 pounds, or 19.00 per cent.
Dressed weight gained during experiment,	143.37 pounds.

Cost of Feed consumed during Experiment.

266.31 pounds barley meal, at $30.00 per ton,	$3 99
160.25 gallons skim-milk, at 1 8 cents per gallon,	2 88
64.04 pounds wheat bran, at $18.50 per ton,	59
82.10 pounds gluten meal, at $22.00 per ton,	91
	$8 37

2.85 pounds of dry matter fed yielded 1 pound of live weight, and 3.52 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.84 cents.

(5)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period. (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.	
1889.								lb.	oz.
April 30 to May 13, .	5.75	46.00	–	–	1 : 2 90	18 50	30.50		14
May 14 to June 17, .	21.88	175.00	17.38	34.75	1 : 2.99	30 50	83.00	1	8
June 18 to July 22, .	96.36	175 00	24.09	24.09	1 : 4.17	83.00	135.75	1	8
July 23 to Aug. 28, .	146.52	184.00	24.42	24.42	1 : 4.65	135.75	182.00	1	4

Total Amount of Feed consumed from April 30 to August 28.

270.51 pounds barley meal, equal to dry matter, . .	235.61 pounds.
580.00 quarts skim-milk, equal to dry matter, . .	128 63 pounds.
65.89 pounds wheat bran, equal to dry matter, . .	58.69 pounds.
83.26 pounds gluten meal, equal to dry matter, . .	74.78 pounds.
Total amount of dry matter, ...	497.71 pounds.

Live weight of animal at beginning of experiment, .	18.50 pounds.
Live weight of animal at time of killing, . . .	182.00 pounds.
Live weight gained during experiment, ...	163.50 pounds.
Dressed weight at time of killing, ...	145.50 pounds.
Loss in weight by dressing, . .	36.50 pounds, or 20 05 per cent.
Dressed weight gained during experiment, . . .	130.72 pounds.

Cost of Feed consumed during Experiment.

270.51 pounds barley meal, at $30.00 per ton, ...	$4 06
145.00 gallons skim-milk, at 1.8 cents per gallon, . . .	2 61
65.89 pounds wheat bran, at $18.50 per ton, ...	61
83 26 pounds gluten meal, at $22.00 per ton, ...	92
	$8 20

3.04 pounds of dry matter fed yielded 1 pound of live weight, and 3.81 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.27 cents.

(6)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.	
1889.								lb.	oz.
April 30 to May 13, .	5.75	46.00	–	–	1:2.90	14.00	25.75		13
May 14 to June 17, .	21.88	175.00	13.13	26.25	1:2.98	25.75	71.50	1	5
June 18 to July 22, .	89.55	175.00	22.37	22.37	1:4.11	71.50	121.00	1	7
July 23 to Aug. 28, .	140.46	184.00	23.41	23.41	1:4.61	121 00	177.00	1	8

Total Amount of Feed consumed from April 30 to August 28.

257.59 pounds barley meal, equal to dry matter, . .	224.36 pounds.
580.00 quarts skim-milk, equal to dry matter, . .	128.63 pounds.
58.91 pounds wheat bran, equal to dry matter, . .	52.48 pounds.
72 03 pounds gluten meal, equal to dry matter, . .	64.69 pounds.
Total amount of dry matter, ...	470.16 pounds.

Live weight of animal at beginning of experiment, .	14.00 pounds.
Live weight of animal at time of killing, ...	177.00 pounds.
Live weight gained during experiment, ...	163.00 pounds.
Dressed weight at time of killing, ...	141.00 pounds.
Loss in weight by dressing, . .	36.00 pounds, or 20.34 per cent.
Dressed weight gained during experiment, ...	129.85 pounds.

Cost of Feed consumed during Experiment.

257.59 pounds barley meal, at $30.00 per ton, ...	$3 86
145.00 gallons skim-milk, at 1.8 cents per gallon, ...	2 61
58.91 pounds wheat bran, at $18.50 per ton, ...	54
72.03 pounds gluten meal, at $22.00 per ton, ...	79
	$7 80

2.88 pounds of dry matter fed yielded 1 pound of live weight, and 3.62 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.01 cents.

(7)

PERIODS.	Total Amount of Barley Meal consumed (Pounds).	Total amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period.
1889.								lb. oz.
April 30 to May 13,	5.75	46.00	–	–	1 :2.90	18.75	30.25	13
May 14 to June 17,	21.88	175.00	16.41	32.83	1 :2.99	30.25	79.75	1 7
June 18 to July 22,	96.12	175.00	24.03	24.03	1 :4.17	79.75	134.50	1 9
July 23 to Aug. 28,	141.84	184.00	23.64	23.64	1 :4.62	134.50	197.50	1 11

Total Amount of Feed consumed from April 30 to August 28.

265.59 pounds barley meal, equal to dry matter,	231.33 pounds.
580.00 quarts skim-milk, equal to dry matter,	128.63 pounds.
64.11 pounds wheat bran, equal to dry matter,	57.11 pounds.
80.55 pounds gluten meal, equal to dry matter,	72.34 pounds.
Total amount of dry matter,	489.41 pounds.

Live weight of animal at beginning of experiment,	18.75 pounds.
Live weight of animal at time of killing,	197.50 pounds.
Live weight gained during experiment,	178.75 pounds.
Dressed weight at time of killing,	159.00 pounds.
Loss in weight by dressing, 38.50 pounds, or	19.49 per cent.
Dressed weight gained during experiment,	143.91 pounds.

Cost of Feed consumed during Experiment.

265.59 pounds barley meal, at $30.00 per ton,	$3 98
145.00 gallons skim-milk, at 1.8 cents per gallon,	2 61
64.11 pounds wheat bran, at $18 50 per ton,	59
80.55 pounds gluten meal, at $22.00 per ton,	89
	$8 07

2.74 pounds of dry matter fed yielded 1 pound of live weight, and 3.40 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.61 cents.

Summary of Experiment (X.).

	Barley Meal (Pounds).	Skim-milk (Gallons).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	LiveWeight gained during Experiment (Pounds).	Dressed Weight gained during Experiment (Pounds).	Cost per Pound of Dressed Pork (Cents).
1, ...	263.97	160.25	64.78	83.47	162.00	134.41	6.22
2, ...	260.49	160.25	63.57	82.32	173.75	142.32	5.82
3, ...	259.51	159.75	60.36	76.25	168.75	135.19	6 04
4, ...	266.31	160.25	64.04	82.10	177.00	143.37	5.84
5, ...	270.51	145.00	65.89	83.26	163.50	130.72	6.27
6, ...	257.59	145.00	58.91	72.03	163.00	129.85	6.01
7, ...	265.59	145.00	64.11	80.55	178.75	143.91	5.61
	1,843.97	1,075.50	441.66	559.98	1,186.75	959.77	–

Total Cost of Feed consumed during the Above-stated Experiment.

1,843.97 pounds barley meal, at $30.00 per ton, ...	$27 66
1,075.50 gallons skim-milk, at 1.8 cents per gallon, . .	19 36
441.66 pounds wheat bran, at $18.50 per ton, ...	4 08
559.98 pounds gluten meal, at $22.00 per ton, ...	6 16
	$57 26

Average cost of feed for production of 1 pound of dressed pork, 5.97 cents.

Manurial Value of Feed consumed during the Above-stated Experiment.

Barley Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
$5 74	$10 13	$2 93	$4 17	$22 97

Manurial value of feed for production of 1 pound of dressed pork, 2.39 cents.

Net cost of feed for the production of 1 pound of dressed pork, 4.29 cents.

Barley Meal (*Average*).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.90	258.00	–	–	1 : 8.81
Dry matter, . . .	87.00	1,742.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	2.30	46.00	–	–	
" cellulose, . . .	7.11	142.20	17.06	12	
" fat, ...	1.94	38.80	26.38	68	
" protein (nitrogenous matter), . .	10.80	216.00	168.48	78	
Non-nitrogenous extract matter, ...	77.85	1,557.00	1,401.30	90	
	100.00	2,000.00	1,613.22	–	

Skim-milk (*Average*).

[One quart equals 2.17 pounds.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	89.78	1,795.60	–	–	1 : 2.13
Dry matter, . . .	10.22	204.40	–	–	
	100.00	2,000 00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.85	137.00	–	–	
" cellulose, . . .	–	–	–	–	
" fat, ...	3.82	76.40	76.40	100	
" protein (nitrogenous matter), . .	31.60	632.00	632.00	100	
Non-nitrogenous extract matter, ...	57.73	1,155.60	1,155.60	100	
	100.00	2,000.00	1,864.00	–	

Wheat Bran (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.92	218.40	–	–	1 : 3.99
Dry matter,	89.08	1,781.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.00	140.00	–	–	
" cellulose,	11.52	230.40	46.08	20	
" fat,	5.43	108.60	86.88	80	
" protein (nitrogenous matter),	17.17	343.40	302.19	88	
Non-nitrogenous extract matter,	58.88	1,177.60	942.08	80	
	100.00	2,000.00	1,377.23	–	

Gluten Meal (Average).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.19	203.80	–	–	1 : 2.86
Dry matter,	89.81	1,796.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.57	11.40	–		
" cellulose,	.56	11.20	3.81	34	
" fat,	6.40	128.00	97.28	76	
" protein (nitrogenous matter),	29.45	589.00	500.65	85	
Non-nitrogenous extract matter,	63.02	1,260.40	1,184.78	94	
	100.00	2,000.00	1,786.52	–	

VI. FODDER ANALYSES. (1889.)

The majority of the analyses stated under the above heading are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

In presenting these analyses, it seems but proper to call the attention of farmers once more forcibly to a careful consideration of the following facts.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind after it has served its purpose as a constituent of the food consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

The higher or lower commercial value of the manurial refuse left behind after the feed has accomplished its purpose in a satisfactory degree, decides its actual or net cost in farm industry. A disregard of this circumstance renders, in many instances, a remunerative dairying not less doubtful than a profitable feeding of live stock for the meat market.

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	16.44	328.80	–	–	1 : 7.92
Dry matter,	83.56	1,671.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	2.02	40.40	–	–	
" cellulose,	2.09	41.80	14.21	34	
" fat,	3.47	69.40	52.74	76	
" protein (nitrogenous matter),	12.27	245.40	208.69	85	
Non-nitrogenous extract matter,	80.15	1,603.00	1,506.82	94	
	100.00	2,000.00	1,782.46	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.13	242.60	–	–	1 : 9.68
Dry matter,	87.87	1,757.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.46	29.20	–	–	
" cellulose,	1.79	35.80	12.17	34	
" fat,	4.36	87.20	66.27	76	
" protein (nitrogenous matter),	10.44	208.80	177.48	85	
Non-nitrogenous extract matter,	81.95	1,639.00	1,540.66	94	
	100.00	2,000.00	1,796.58	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.71	214.20	–	–	1 : 10
Dry matter,	89.29	1,785.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.00	20.00	–	–	
" cellulose,	1.74	34.80	11.83	34	
" fat,	4.22	84.40	64.14	76	
" protein (nitrogenous matter),	10.19	203 80	173.23	85	
Non-nitrogenous extract matter,	82.85	1,657.00	1,557 60	94	
	100.00	2,000 00	1,806.80	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.98	239.60	–	–	1 : 8 47
Dry matter,	88.02	1,760.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.56	31.20	–	–	
" cellulose,	1.85	37.00	12.58	34	
" fat,	4.69	93.80	71.29	76	
" protein (nitrogenous matter),	11.79	235.80	200.43	85	
Non-nitrogenous extract matter,	80.11	1,602.20	1,506.07	94	
	100.00	2,000.00	1,790.37	–	

Corn Meal.

[Amherst Mill.]

92.34 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.36	–	–	–	1 : 9.17
Dry matter,	86.64	–	–	–	
	100.00	–	–	–	
Analysis of Dry Matter.					
Crude ash,	1.28	25.60	–	–	
“ cellulose,	2.28	45.60	15.50	34	
“ fat,	3.18	63.60	48.34	76	
“ protein (nitrogenous matter),	10.82	216.40	183.94	85	
Non-nitrogenous extract matter,	82.44	1,648.80	1,549.87	94	
	100.00	2,000.00	1,797.65	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.51	310.20	–	–	1 : 8.54
Dry matter,	84.49	1,689.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.60	32.00	–	–	
“ cellulose,	1.74	34.80	11.83	34	
“ fat,	4.54	90.80	69.01	76	
“ protein (nitrogenous matter),	11.69	233.80	198.73	85	
Non-nitrogenous extract matter,	80.43	1,608.60	1,512.08	94	
	100.00	2,000.00	1,791.65	–	

Corn Meal.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.32	226.40	–	–	1 : 9.89
Dry matter,	88.68	1,773.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.53	30.60	–	–	
" cellulose,	1.20	24.00	8.16	34	
" fat,	4.30	86.00	65.36	76	
" protein (nitrogenous matter),	10.26	205 20	174.42	85	
Non-nitrogenous extract matter,	82.71	1,654.20	1,554.95	94	
	100.00	2,000.00	1,802.89	–	

Corn Meal.

[Amherst Mill.]

88.50 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.05	201.00	–	–	1 : 9.14
Dry matter,	89.95	1,799.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.63	32.60	–	–	
" cellulose,	1.34	26.80	9.11	34	
" fat,	4.18	83.60	63.54	76	
" protein (nitrogenous matter),	10.98	219.80	186.66	85	
Non-nitrogenous extract matter,	81.87	1,637.40	1,539.15	94	
	100.00	2,000.00	1,798.46	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.57	191.40	–	–	1 : 4.06
Dry matter,	90.43	1,808.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.90	118.00	–	–	
" cellulose,	10.08	201.60	40.32	20	
" fat,	4.78	95.60	76.48	80	
" protein (nitrogenous matter),	17.06	341.20	302.26	88	
Non-nitrogenous extract matter,	62.18	1,243.60	994.88	80	
	100.00	2,000.00	1,413.94	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.34	226.80	–	–	1 : 3.70
Dry matter,	88.66	1,773.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.56	131.20	–	–	
" cellulose,	11.27	225.40	45.08	20	
" fat,	4.64	92.80	74.24	80	
" protein (nitrogenous matter),	18.13	362.60	319.09	88	
Non-nitrogenous extract matter,	59.40	1,188.80	950.40	80	
	100.00	2,000.00	1,388.81	–	

Wheat Bran.

[Amherst Mill.]

40.11 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.34	186.80	–	–	1 : 3.63
Dry matter, . . .	90.66	1,813.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.67	133.40	–	–	
" cellulose, . . .	10.88	217.60	43.52	20	
" fat, ...	3.59	71.80	57.44	80	
" protein (nitrogenous matter), . .	18.13	362.60	319.09	88	
Non-nitrogenous extract matter, ...	60.73	1,214.60	971.68	80	
	100.00	2,000.00	1,391.73	–	

Wheat Bran.

[Amherst Mill.]

19.56 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.41	208.20	–	–	1 : 4.08
Dry matter, . . .	89.59	1,791.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.99	139.80	–	–	
" cellulose, . . .	12.02	240.40	48.08	20	
" fat, ...	5.46	119.20	95.36	80	
" protein (nitrogenous matter), . .	17.02	340.40	299.55	88	
Non-nitrogenous extract matter, ...	58.51	1,170.20	936.16	80	
	100.00	2,000.00	1,379.15	–	

Wheat Bran.

[Amherst Mill.]

17.97 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.42	228.40	–	–	1 : 3.97
Dry matter,	88.58	1,771.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.00	140.00	–	–	
“ cellulose,	11.03	220.60	44.12	20	
“ fat,	5.40	108.00	86.40	80	
“ protein (nitrogenous matter),	17.31	346.20	304.66	88	
Non-nitrogenous extract matter,	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,383.34	–	

Wheat Bran.

[Amherst Mill.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.85	177.00	–	–	1 : 4.23
Dry matter,	91.15	1,823.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.54	150.80	–	–	
“ cellulose,	9.64	192.80	38.56	20	
“ fat,	5.16	103.20	82.52	80	
“ protein (nitrogenous matter),	16.45	329.00	289.52	88	
Non-nitrogenous extract matter,	61.21	1,224.20	979.36	80	
	100.00	2,000.00	1,389.96	–	

Wheat Bran.

[I. sent on by T. P. Root, Barre, Mass.; II. and III. sent on by E. D. Gibson, Ashburnham, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.10	11.36	11.64
Dry matter,	91.90	88.64	88.36
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.89	6.98	7.42
" cellulose,	10.73	5.95	5.60
" fat,	5.40	7.49	9.43
" protein (nitrogenous matter),	16.73	17.97	16.13
Non-nitrogenous extract matter,	60 25	61.61	61.42
	100.00	100.00	100.00
Passed screen 144 meshes to square inch,	29.57	24.89	16.03

Gluten Meal.

[Springfield, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.49	189.80	–	–	1 : 2.84
Dry matter,	90.51	1,810.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	.04	.80	–	–	
" cellulose,	.27	5.40	1.84	34	
" fat,	6.69	133.80	101.69	76	
" protein (nitrogenous matter),	29.87	597.40	507.79	85	
Non-nitrogenous extract matter,	63.13	1,262.60	1,186.84	94	
	100.00	2,000.00	1,798.16	–	

Gluten Meal.

[Springfield, Mass.]

50.24 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.50	210.00	–	–	1 : 2.93
Dry matter, . . .	89 50	1,790.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.34	6.80	–	–	
“ cellulose, . . .	.41	8.20	2.79	34	
“ fat, ...	7.08	141.60	107.62	76	
“ protein (nitrogenous matter), . .	29.19	583.80	496.23	85	
Non-nitrogenous extract matter, ...	62.98	1,259.60	1,184.02	94	
	100.00	2,000.00	1,790.66	–	

Gluten Meal.

[Springfield, Mass.]

56.14 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.29	225.80	–	–	1 : 2.59
Dry matter, . . .	88.71	1,774 20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	.73	14.60	–	–	
“ cellulose, . . .	.69	13.80	4.69	34	
“ fat, ...	4.08	81.60	62.02	76	
“ protein (nitrogenous matter), . .	30.86	617.20	524.62	85	
Non-nitrogenous extract matter, ...	63.64	1,272.80	1,196.43	94	
	100.00	2,000.00	1,787.76	–	

Gluten Meal.

[Springfield, Mass.]

[1.50 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C. . . .	9.89	197.80	–	–	
Dry matter.	90.11	1,802.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash.	.79	15.80	–	–	1 : 2.79
" cellulose. . . .	.71	14.20	4.83	34	
" fat.	5.72	114.40	86.94	76	
" protein (nitrogenous matter). . . .	29.72	594.40	505.24	85	
Non-nitrogenous extract matter. . .	63.06	1,261.20	1,185.53	94	
	100.00	2,000.00	1,782.54	–	

Gluten Meal.

[Sent on from Boston, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C. . . .	7.85	157.00	–	–	
Dry matter.	92.15	1,843.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash.	1.82	36.40	–	–	1 : 1.89
" cellulose. . . .	1.61	32.20	10.95	34	
" fat.	17.36	347.20	263.87	76	
" protein (nitrogenous matter). . . .	41.10	822.00	698.70	85	
Non-nitrogenous extract matter.	38.11	762.20	716.47	94	
	100.00	2,000.00	1,689.99	–	

Gluten Meal.

[Sent on by W. H. Fairbanks, Sudbury, Mass.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.62	192.40	–	–	1 : 3.663
Dry matter	90.38	1,807.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash	.95	19.00	–	–	
" cellulose	4.26	85.20	28.97	34	
" fat	7.82	156.40	118.86	76	
" protein (nitrogenous matter)	24.34	486.80	413.78	85	
Non-nitrogenous extract matter	62.63	1,252.60	1,177.44	94	
	100.00	2,000.00	1,739.05	–	

Gluten Meal.

[Springfield, Mass.]

44.39 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.	9.80	196.00	–	–	1 : 2.558
Dry matter	90.20	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash	1.25	25.00	–	–	
" cellulose	1.75	35.00	11.90	34	
" fat	7.00	140.00	106.40	76	
" protein (nitrogenous matter)	31.25	625.00	531.25	85	
Non-nitrogenous extract matter	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,774.05	–	

Old Process Linseed Meal.

[Springfield, Mass.]

75.52 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C ,	10.46	209.20	–	–	1 : 1.63
Dry matter,	89.54	1,790.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.08	141.60	–	–	
" cellulose,	8.51	170 20	44.25	26	
" fat,	7.98	159.60	145.24	91	
" protein (nitrogenous matter),	38.67	773.40	671.86	87	
Non-nitrogenous extract matter,	37.76	755.20	687.23	91	
	100.00	2,000.00	1,548.58	–	

Old Process Linseed Meal (Fine).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	7.48	149.60	–	–	1 : 1 76
Dry matter,	92.52	1,850.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.67	113.40	–	–	
" cellulose,	8.04	16.08	41.80	26	
" fat,	7.40	148.00	134.68	91	
" protein (nitrogenous matter),	37.15	743.00	646.41	87	
Non-nitrogenous extract matter,	41.74	834.80	759.67	91	
	100.00	2,000.00	1,582,56	–	

Fertilizing Constituents of Old Process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	7.480
Calcium oxide,	.671
Magnesium oxide,	.827
Ferric oxide,	.060
Potassium oxide (4¼ cents per pound),	1.379
Phosphoric acid (6 cents per pound),	1.548
Nitrogen (17 cents per pound),	5.508
Insoluble matter,	.214
Valuation per ton,	$21 76

New Process Linseed Meal (Coarse).

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	6.01	120.20	–	–	1 : 1.32
Dry matter,	93.99	1,879.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.04	120.80	–	–	
" cellulose,	9.23	184.60	48.00	26	
" fat,	3.14	62.80	57.15	91	
" protein (nitrogenous matter),	40.76	815.20	709.22	87	
Non-nitrogenous extract matter,	40.83	816.60	743.11	91	
	100.00	2,000.00	1,557.48	–	

Fertilizing Constituents of New Process Linseed Meal.

	Per Cent.
Moisture at 100° C.,	6.010
Calcium oxide,	.552
Magnesium oxide,	.534
Ferric oxide,	.047
Potassium oxide (4¼ cents per pound),	1.517
Phosphoric acid (6 cents per pound),	1.651
Nitrogen (17 cents per pound),	6.112
Insoluble matter,	.192
Valuation per ton,	$24 05

Linseed Meal.

[I., new process, sent on by T. P. Root, Barre, Mass.; II., old process, sent on by S. P. Puffer, North Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.58	10.43
Dry matter,	91.42	89.57
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.52	8.37
" cellulose,	10.31	9.69
" fat,	3.18	6 24
" protein (nitrogenous matter),	32.50	30.98
Non-nitrogenous extract matter,	46.49	44.72
	100.00	100.00

Fine Feed.

[Sent on by T. P. Root, Barre, Mass.]

	Per Cent.
Moisture at 100° C.,	7.76
Dry matter,	92.24
	100.00
Analysis of Dry Matter.	
Crude ash,	4.60
" cellulose,	5.81
" fat,	5.59
" protein (nitrogenous matter),	21.58
Non-nitrogenous extract matter,	62.42
	100.00

Barley Meal.

[Springfield, Mass.]

77.86 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.19	243.80	–	–	1 : 8.53
Dry matter, . . .	87.81	1,756.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.82	36.40	–	–	
" cellulose, . . .	7.37	147.40	17.69	12	
" fat, ...	2.19	43.80	29.78	68	
" protein (nitrogenous matter), . .	11.17	223.40	174.25	78	
Non-nitrogenous extract matter, ...	77.45	1,549.00	1,394.10	90	
	100.00	2,000.00	1,615.82	–	

Barley Meal.

[Springfield, Mass.]

57.71 per cent. passed screen 144 meshes to square inch.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.61	272.20	–	–	1 : 9.11
Dry matter, . . .	86.39	1,727.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	2.79	55.80	–	–	
" cellulose, . . .	6.85	137.00	16.44	12	
" fat, ...	1.69	33.80	22.95	68	
" protein (nitrogenous matter), . .	10.42	208.40	162.55	78	
Non-nitrogenous extract matter, ...	78.25	1,565.00	1,408.50	90	
	100.00	2,000.00	1,610.44	–	

White Soja Beans.

[Bought in New York.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	5.85	117.00	–	–	1 : 1.97
Dry matter,	94.15	1,883.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.57	111.40	–	–	
“ cellulose,	5.15	103.00	14.94	14.5	
“ fat,	18 42	368.40	330.82	89.8	
“ protein (nitrogenous matter),	35.98	719.60	647.64	90.0	
Non-nitrogenous extract matter,	34.88	697.60	432.51	62.0	
	100.00	2,000.00	1,425.91	–	

White Soja Beans.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	17.38	347.60	–	–	1 : 2.37
Dry matter,	82.62	1,652.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	5.22	104.40	–	–	
“ cellulose,	5.35	107.00	15.52	14.5	
“ fat,	21.89	437.80	393.74	89.8	
“ protein (nitrogenous matter),	33.36	667.20	600.48	90.0	
Non-nitrogenous extract matter,	34.18	683.60	423.83	62.0	
	100.00	2,000.00	1,432.97	–	

Fertilizing Constituents of White Soja Beans.

	Per Cent.
Moisture at 100° C,	17.380
Calcium oxide,	.342
Magnesium oxide,	.869
Ferric oxide,	.231
Sodium oxide,	.166
Potassium oxide (4¼ cents per pound),	2.085
Phosphoric acid (6 cents per pound),	1.851
Nitrogen (17 cents per pound),	4.409
Insoluble matter,	.090
Valuation per ton,	$18 98

Black Soja Beans.

[Experiment Station, 1888.]

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.27	385.40	–	–	1 : 2.28
Dry matter,	80.73	1,614.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.73	134.60	–	–	
" cellulose,	7.57	151.40	21.95	14.5	
" fat,	20.25	405.00	363.69	89.8	
" protein (nitrogenous matter),	32.58	651.60	586.44	90.0	
Non-nitrogenous extract matter,	32.87	657.40	407.59	62.0	
	100.00	2,000.00	1,379.67	–	

Fertilizing Constituents of Black Soja Beans.

	Per Cent.
Moisture at 100° C.,	19.270
Calcium oxide,	.495
Magnesium oxide,	.949
Ferric oxide,	.201
Sodium oxide,	.384
Potassium oxide (4¼ cents per pound),	1.896
Phosphoric acid (6 cents per pound),	1.886
Nitrogen (17 cents per pound),	4.208
Insoluble matter,	.095
Valuation per ton,	$18 18

Corn "Husks" or "Chaff."

[Sent on by C. Brigham & Co., Northborough, Mass.]

	Per Cent.
Moisture at 100° C.,	13.26
Dry matter,	86.74
	100.00

Analysis of Dry Matter.

Crude ash,	2.76
" cellulose,	18.91
" fat,	1.61
" protein (nitrogenous matter),	5.61
Non-nitrogenous extract matter,	71.11
	100.00

1.55 per cent. passed screen 144 meshes to square inch.

Corn "Germs."

[Sent on by C. Brigham & Co., Northborough, Mass.]

	Per Cent.
Moisture at 100° C.,	13.02
Dry matter,	86.98
	100.00

Analysis of Dry Matter.

Crude ash,	3.09
" cellulose,	2.25
" fat,	6.01
" protein (nitrogenous matter),	11.20
Non-nitrogenous extract matter,	77.45
	100.00

46.77 per cent. passed screen 144 meshes to square inch.

Low Meadow Hay.

[Sent on by S. N. Thompson, Southborough, Mass.]

	Per Cent.
Moisture at 100° C.,	8.01
Dry matter,	91.99
	100.00

Analysis of Dry Matter.

Crude ash,	6.75
" cellulose,	35.59
" fat,	1.88
" protein (nitrogenous matter),	9.51
Non-nitrogenous extract matter,	46.27
	100.00

Corn Stover.

[Sent on by J. C. Dillon, Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	15.60	17.22
Dry matter,	84.40	82.78
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	8.00	4.53
" cellulose,	38.24	28.41
" fat,	1.17	1.41
" protein (nitrogenous matter),	7.94	6.07
Non-nitrogenous extract matter,	44.65	60.08
	100.00	100.00

Ensilage.

[I. and II. sent on by J. N. Raymond, Beverly, Mass.; III. sent on by B. C. Haskell, Boston, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	80.77	78.98	79.73
Dry matter,	19.23	21.02	20.27
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	5 08	4.71	3,19
" cellulose,	33.99	33.79	28.43
" fat,	2.71	1.94	3.60
" protein (nitrogenous matter),	10.26	7.74	7.49
Non-nitrogenous extract matter,	47.96	51.82	57.29
	100.00	100.00	100.00

Barley and Oat Chaff.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.49
Dry matter,	86.51
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	10.41
" cellulose,	24.30
" fat,	2.40
" protein (nitrogenous matter),	11.78
Non-nitrogenous extract matter,	51.11
	100.00

Fertilizing Constituents of Barley and Oat Chaff.

Moisture at 100° C.,	13.490
Calcium oxide,	.853
Magnesium oxide,	.346
Ferric oxide,	.072
Sodium oxide,	.035
Potassium oxide (4¼ cents per pound),	1.146
Phosphoric acid (6 cents per pound),	.409
Nitrogen (17 cents per pound),	1.650
Insoluble matter,	.272
Valuation per ton,	$7 07

Soja Bean (Entire Plant).

[Collected Aug. 26, 1889.]

	Per Cent.
Moisture at 100° C.,	6.48
Dry matter,	93.52
	100.00

Analysis of Dry Matter.

Crude ash,	8.55
" cellulose,	21.75
" fat,	6.35
" protein (nitrogenous matter),	15.10
Non-nitrogenous extract matter,	48.25
	100.00

In green material, moisture, 73.43 per cent.; dry matter, 26.57 per cent.

Fertilizing Constituents of Soja Bean.

Moisture at 100° C.,	6.480
Calcium oxide,	2.750
Magnesium oxide,	1.165
Ferric oxide,	.099
Sodium oxide,	.098
Potassium oxide (4¼ cents per pound),	1.546
Phosphoric acid (6 cents per pound),	.581
Nitrogen (17 cents per pound),	2.259
Insoluble matter,	.987
Valuation per ton,	$9 69

Spanish or Long Moss (Tillandsia usneoides).

	Per Cent.
Moisture at 100° C.,	60.80
Dry matter,	39.20
	100.00

Analysis of Dry Matter.

Crude ash,	2.67
" cellulose,	32.61
" fat,	2.54
" protein (nitrogenous matter),	4.45
Non-nitrogenous extract matter,	57.73
	100.00

Fertilizing Constituents of Spanish Moss.

Moisture at 100° C.,	60.80
Calcium oxide,	.089
Magnesium oxide,	.122
Ferric and aluminic oxides,	.029
Sodium oxide,	.263
Potassium oxide (4¼ cents per pound),	.255
Phosphoric acid (6 cents per pound),	.030
Nitrogen (17 cents per pound),	.279
Insoluble matter,	.191
Valuation per ton,	$1 21

Palmetto Root.

[Sent on by C. D. Duncan, Mandarin, Fla.]

	Per Cent.
Moisture at 100° C.,	11.51
Dry matter,	88.49
	100.00

Analysis of Dry Matter.

Crude ash,	4.44
" cellulose,	21.26
" fat,	.53
" protein (nitrogenous matter),	3.82
Non-nitrogenous extract matter,	69.95
	100.00
Starch (in dry matter),	49.84
Sugar,	Trace.
Tannin,	Trace.

Fertilizing Constituents of Palmetto Root.

Moisture at 100° C.,	11.510
Ash,	3.930
Calcium oxide,	.045

	Per Cent.
Magnesium oxide,	.004
Ferric oxide,	.017
Sodium oxide,	.345
Potassium oxide (4¼ cents per pound),	1.380
Phosphoric acid (6 cents per pound),	.157
Nitrogen (17 cents per pound),	.540
Insoluble matter,	.410
Valuation per ton,	$3 20

Result of Examination of Fifty-pound Samples of the Corn entered by Competitors in This State for the American Agriculturist Prize.

1. Proportion of Moisture, Kernels and Cobs.

NAME AND ADDRESS OF COMPETITORS.	PER CENT. OF COMPOSITION.			PER CENT. OF MOISTURE.		RATIO OF COBS TO KERNELS.	
	Water.	Kernels	Cobs.	Kernels	Cobs.	As Received.	At 100° C.
1. W. S. Westcott, Amherst,	31.30	58.88	9.82	23.26	57.38	1 : 3.60	1 : 5.99
2. J. C. Dillon, Amherst,	40.74	52.30	6.96	33.50	67.40	1 : 3.96	1 : 7.51
3. F. Goodwin, Framingham,	32.59	59.17	8.24	29.87	46.12	1 : 4.23	1 : 7.06
4. J. S. Wells, Hatfield,	37.28	54.66	8.06	33.49	54.77	1 : 3.60	1 : 6.78
5. Henry Tillson, Sunderland,	32.02	58.46	9.52	28.75	46.96	1 : 5.61	1 : 6.17
6. G. P. Smith, Sunderland,	30.31	59.29	10.40	22.36	56.00	1 : 3.53	1 : 5.70
7. John Brooks, Princeton,	28.27	61.46	10.27	24.98	45.75	1 : 3.62	1 : 6.98
Averages,	33.22	57.74	9.03	28.15	53.48	1 : 4.02	1 : 6.60

2. Description of Ears.

KIND OF CORN.	Number of Ears.	AVERAGE WEIGHT OF EARS (GRAMS).		AVERAGE WEIGHT OF KERNELS (GRAMS).		Average Length of Ears (Inches).
		As Received.	At 100° C.	As Received	At 100° C.	
1. Yellow Flint,	125	177.4	121.9	.368	.281	8⅜
2. Yellow Dent,	96	222.9	132.1	.297	.197	7⅜
3. Yellow Flint,	102	209.8	141.8	.452	.317	9⅞
4. Yellow Dent,	67	319.4	200.3	.452	.300	8¼
5. Yellow Dent,	129	173.6	118.0	.384	.273	6⅜
6. Yellow and White Flint,	115	194.7	135.7	.457	.355	9⅛
7. White Flint,	135	167.9	120.5	.415	.312	8
Averages,	110	209.4	139.9	.404	.291	8¼

3. *Fodder Constituents in Kernels* (*Per Cent.*).

	Moisture at 100° C.	Dry Matter.	ANALYSIS OF DRY MATTER.					Nutritive Ratio.
			Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	
1, ...	23.26	76.74	1.77	1.07	4.69	8.49	83.98	1 : 12.22
2, ...	33.50	66.50	1.65	1.40	4.42	9.37	83.16	1 : 10.93
3, ...	29.87	70.13	1.99	1.03	5.32	11.58	80.08	1 : 8.72
4, ...	33.49	66.51	1.95	1.51	5.45	11.14	79.95	1 : 9.08
5, ...	28.75	71.25	1.19	1.71	5.09	9.27	82.74	1 : 11.17
6, ...	22.36	77.64	1.44	1.36	4.96	13.36	78.88	1 : 7.40
7, ...	24.98	75.02	2.09	1.27	5.28	12.27	79.09	1 : 8.45
Averages, .	28.03	71.97	1.73	1.33	5.03	10.78	81.13	1 : 9.71

Per Cent. of Digestibility of Constituents.

Crude cellulose, ...	34
" fat, ...	76
" protein, ...	85
Non-nitrogenous extract matter, ...	94

4. *Fertilizing Constituents in Dry Matter* (*Per Cent.*).

	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Sodium Oxide.	Potassium Oxide.	Phosphoric Acid.	Nitrogen.	Insoluble Matter.	Valuation per 2,000 Pounds Dry Matter.
1, ...	.028	.200	.017	.033	.274	.624	1.35	.040	$5 57
2, ...	.114	.193	.054	.025	.318	.845	1.49	.032	6 35
3, ...	.036	.222	.022	.038	.349	.772	1.85	.038	7 52
4, ...	.027	.169	.015	.023	.389	.492	1.78	.018	6 67
5, ...	.026	.164	.009	.028	.342	.457	1.49	.009	5 91
6, ...	.034	.231	.041	.028	.462	.638	1.97	.013	7 86
7, ...	.022	.264	.020	.031	.407	.859	1.96	.020	8 03
Averages, . .	.041	.206	.025	.029	.363	.670	1.70	.024	$6 85

Potassium oxide, 4¼ cents per pound; phosphoric acid, 6 cents; nitrogen, 17 cents.

ON FIELD EXPERIMENTS.

I. Field experiments to compare the influence of an addition of nitrogen in different combinations to the soil under cultivation, on the general character of the crop and on the annual yield.

II. Influence of fertilizers on the quantity and quality of prominent fodder crops.

III. Experiments with field and garden crops.

IV. Experiments with green crops for summer feed of milch cows.

V. Notes on miscellaneous field work.

VI. Prof. James E. Humphrey's report on fungi, etc.

I. FIELD EXPERIMENTS TO COMPARE THE INFLUENCE OF AN ADDITION OF NITROGEN IN DIFFERENT COMBINATIONS TO THE SOIL UNDER CULTIVATION, ON THE GENERAL CHARACTER OF THE CROP AND ON THE ANNUAL YIELD. (FIELD A.)

The area assigned to this investigation is the same which has been used in preceding years to study our lands with reference to the conditions of the inherent natural resources of potash. The previous system of subdivision into plats, one-tenth of one acre in size, is retained in all its details. The record of each plat, as far as modes of cultivation and of manuring are concerned, extends over more than five successive years. This circumstance served as one of the inducements to undertake the above-stated task.

Some plats had received during that period a supply of nitrogen for manurial purposes in but one and the same specified form, while others had received none in any form. This condition of the various plats was turned to proper account in our new plans. Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes, were retained in that state to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation; while the remaining ones received, as before, a definite amount of nitrogen in the same form in which they had received it in preceding years, namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received, without an exception, a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid, and from 40 to 50 pounds of available nitrogen, were supplied per acre.

One plat, marked 0, received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate, and 18 pounds of dissolved bone-black.

Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 1 and 2 received nitrogen in form of sodium nitrate; plats 5, 6 and 8 received nitrogen in form of ammonium sulphate; plats 3 and 10 received nitrogen in form of dried blood; plat 0 received nitrogen in form of barn-yard manure.

For details, compare the following tables, containing the history of Field A: —

Composition of Manurial Substances applied.

	Per Cent.
Nitrate of soda = nitrogen,	16.00
Sulphate of ammonia = nitrogen,	20.91
Dried blood = nitrogen,	8.24
Muriate of potash = potassium oxide,	48.58
Sulphate of potash = potassium oxide,	37.54
Dissolved bone-black = available phosphoric acid,	21.80
Barn-yard manure = moisture,	73.04
phosphoric acid,	.688
potassium oxide,	.527
nitrogen,	.568

Field A.

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886, 1887, 1888, 1889, planted with "Clark" corn.]

NUMBER OF PLAT.	FERTILIZERS APPLIED.			YIELD OF DRY FODDER CORN.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1, .	25 lbs. sodium nitrate (= 4 lbs nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (= 7 to 8 lbs. nitrogen) and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	480	430	720
Plat 2, .	Nothing, ...	Nothing, ...	Nothing, ...	310	250	165
Plat 3, .	30 lbs. dried blood (= 4 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	60 lbs. dried blood (= 7 to 8 lbs. nitrogen) and 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid), ...	350	310	240
Plat 4, .	Nothing, ...	Nothing, ...	Nothing, ...	300	250	130
Plat 5, .	25 lbs. ammonium sulphate (= 5 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen).	50 lbs. ammonium sulphate (= 10 lbs. nitrogen) and 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide), ...	360	280	635
Plat 6, .	Fallow, ...	Fallow, ...	Fallow, ...	–	–	–
Plat 7, .	50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid) and 50 lbs. muriate of potash (= 25 lbs. potassium oxide), . . .	280	255	730
Plat 8, .	Nothing, ...	Nothing, ...	Nothing, ...	250	195	165
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide).	50 lbs. muriate of potash (= 25 lbs. potassium oxide), ...	945	840	655
Plat 10, .	48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen), ...	845	895	940

Field A — Concluded.

Number of Plat.	Fertilizers Applied.		Yield of Dry Fodder Corn.	
	1888.	1889.	1888.	1889.
Plat 1,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	617	648
Plat 2,	50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen),	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8.5 lbs. available phosphoric acid),	303	577
Plat 3,	100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8.5 lbs available phosphoric acid),	150	618
Plat 4,	Nothing,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	114	381
Plat 5,	97 lbs. magnesium sulphate,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs dissolved bone-black (= 8 5 lbs. available phosphoric acid),	564	488
Plat 6,	Nothing,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	193	542
Plat 7,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	676	526
Plat 8,	50 lbs. ammonium sulphate (= 10 lbs. nitrogen),	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	146	359
Plat 9,	50 lbs. muriate of potash (= 25 lbs. potassium oxide),	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	553	476
Plat 10,	97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen).	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	737	640

The entire field, eleven plats, was ploughed April 9. The fertilizer was applied broadcast to each plat, and subsequently slightly harrowed under, April 27. The final preparation of the soil for seeding, by ploughing and harrowing, took place May 9. The same variety of corn (Clark), a flint corn, was planted in drills in a similar manner as during preceding years, May 10. The crop on all plats was kept clean by means of the cultivator and hoe; it was cut September 3, when the kernels were fairly glazed over. The degree of progress in the growth of the corn upon different plats during the entire season may be noticed from the following tabular statement of periodical measurements of their average heights: —

Height of Corn on Plats, in Inches (1889).

	June 11.	June 19.	June 26.	July 3.	July 10.	July 17.	July 24.	July 31.	Aug. 7.	Aug. 14.	Aug. 21.	Aug. 28.
Plat 0, .	6	9	11	18	25	35	45	64	70	73	73	73
Plat 1, .	6	9	12	16	26	36	44	64	73	73	73	73
Plat 2, .	6	7½	10	15	25	33	42	62	68	70	70	72
Plat 3, .	6½	9	12	14	24	31	41	60	68	73	73	75
Plat 4, .	5½	7	10	13	20	27	33	49	62	65	65	67
Plat 5, .	5½	7½	10	13	23	34	41	55	67	70	70	70
Plat 6, .	6	8	9½	13	20	30	40	61	66	74	74	74
Plat 7, .	6	10	13	16	26	40	48	60	64	68	70	70
Plat 8, .	5	6½	8	10	17	21	30	45	54	60	62	68
Plat 9, .	6	9	10	16	22	33	41	60	63	68	69	69
Plat 10, .	7	11	14	19	27	46	54	69	75	76	76	76

The marked difference in the general appearance of the corn crop on different plats during the various stages of its growth was, however, not confined to their varying heights; they differed also at times much in regard to a more or less healthy color. The growth upon plats 7 and 9, in particular, was, during the entire season, of a light-green color; the same feature was noticeable to some degree, during the first half of the season, on plats 4, 5, 6 and 8. Upon the remaining plats the color was deep green, indicating a vigorous condition. Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 5, 6 and 8 received an addition of nitrogen in form of ammonium sulphate, and the remaining plats in form either of dried blood or of sodium nitrate. Not less noticeable is the difference in the character of the final crop. Those plats (4, 7 and 9) which received no nitrogen in the fertilizer applied, produced not only by far the smallest quantity of ears, but also the smallest number of well-developed ears. The yield in corn stover, on the other hand, is, in two of these cases (7 and 9) at least, equal to the highest on any of the other plats, as may be seen from the following record : —

Yield of Corn Stover and Ears on Plats (1889), at Forty-eight Per Cent. Moisture.

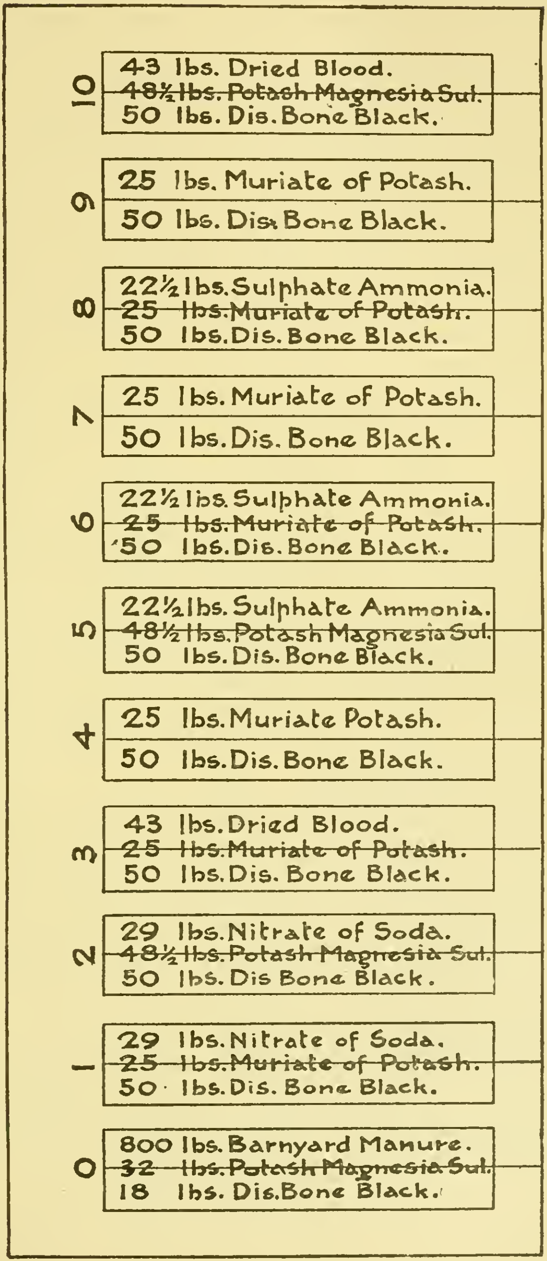
	Weight of Whole Crop.	Weight of Stover.	Weight of Ears.
	Lbs.	Lbs.	Lbs.
Plat 0,	500.62	342.35	158.27
Plat 1,	648.48	475.95	172.53
Plat 2,	576.91	375.75	201.16
Plat 3,	618.31	425.85	192.46
Plat 4,	381.18	283.90	97.28
Plat 5,	488.01	359.05	128.96
Plat 6,	541.95	367.05	174.90
Plat 7,	525.82	484.30	41 52
Plat 8,	359.12	237.98	121.14
Plat 9,	475.63	417.50	58.13
Plat 10,	639.55	467.60	171.95

Percentage of Well-developed and Undeveloped Ears on Plats (1889).

	Well-developed Ears.	Undeveloped Ears.
	Per Cent.	Per Cent.
Plat 0,	60.3	39.7
Plat 1,	48.5	51.5
Plat 2,	46.7	53.3
Plat 3,	28.3	71.7
Plat 4,	14.7	85.3
Plat 5,	18.7	81.3
Plat 6,	29.0	71.0
Plat 7,	41.6	58.4
Plat 8,	21.3	78.7
Plat 9,	24.4	75.6
Plat 10,	50.2	49.8

The results of our first season of observation regarding the influence of nitrogen-containing manurial substances on the character and on the quantity of the fodder corn raised under otherwise corresponding circumstances, although not without some interest, are not decisive enough to advise a detailed explanation of causes. The larger part of the late summer season with us was cold and wet, and for this reason of an exceptionally unfavorable character for the raising of fodder corn. How much this circumstance has affected our results, is difficult to decide. Not less difficult is it to decide, at this stage of observation, how much the special conditions of various plats may yet control the results. The experiment will be continued until a reliable basis for a final conclusion has been secured.

FIELD "A" 1889.


10
43 lbs. Dried Blood.
48½ lbs. Potash Magnesia Sul.
50 lbs. Dis. Bone Black.
9
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
8
22½ lbs. Sulphate Ammonia.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
7
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
6
22½ lbs. Sulphate Ammonia.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
5
22½ lbs. Sulphate Ammonia.
48½ lbs. Potash Magnesia Sul.
50 lbs. Dis. Bone Black.
4
25 lbs. Muriate Potash.
50 lbs. Dis. Bone Black.
3
43 lbs. Dried Blood.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
2
29 lbs. Nitrate of Soda.
48½ lbs. Potash Magnesia Sul.
50 lbs. Dis Bone Black.
1
29 lbs. Nitrate of Soda.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
0
800 lbs. Barnyard Manure.
32 lbs. Potash Magnesia Sul.
18 lbs. Dis. Bone Black.

CORN PLATS WITH DRAINAGE SYSTEM. SCALE, 4 RODS TO 1 INCH.

II. INFLUENCE OF FERTILIZERS ON THE QUANTITY AND QUALITY OF PROMINENT FODDER CROPS. (FIELD B.)

The field is located west of Field A, and has been used, like the latter, for several years previous to the establishment of the experiment station, for the production of hay. The land is nearly on a level, and runs from north to south: it occupies at the present time an area of 1.7 acres. The soil consists of a somewhat sandy loam. In 1884 the entire field was subdivided into eleven plats of equal size, with five feet of space between them. Every alternate plat has received from that date annually the same kind and the same amount of fertilizer, — six hundred pounds of ground bones, and two hundred pounds of muriate of potash per acre. Since 1885 all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and, in the case of grasses, two feet. The space between the different plats has received, thus far, no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 were fertilized annually; plats 12, 14, 16, 18 and 20 have received no fertilizer until the present season, — 1889.

The details of the work carried on upon Field B are from year to year recorded in the annual report of the station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins, and the reports of the succeeding year.

The subsequent tabular statement of crops raised upon the different plats of Field B since 1886 may assist in a desirable understanding of its late history, and its condition at the beginning of the season of 1889. The single plats are, since 1886, each 175 feet long and 33 feet wide.

Statement of Crops raised on Field B.

PLATS.	1887.	1888.	1889.
Plat 11 (fertilized,)	Corn,	Kentucky blue-grass (*Poa prætensis*),	Kentucky blue-grass.
Plat 12 (unfertilized),	Corn,	Kentucky blue-grass,	Kentucky blue-grass (fertilized August, 1889).
Plat 13 (fertilized),	Italian rye-grass (*Lolium Italicum*), English rye-grass (*Lolium perenne*),	Italian rye-grass, English rye-grass,	Red-cob ensilage corn.
Plat 14 (unfertilized),	Italian rye-grass, English rye-grass,	Italian rye-grass, English rye-grass,	Red-cob ensilage corn (fertilized May, 1889).
Plat 15 (fertilized),	Five varieties Southern cow-pea,	Soja bean (*Soja hispida*),	Bokhara clover (*Melilotus alba*). Sainfoin (*Onobrychis sativa*).
Plat 16 (unfertilized),	Five varieties Southern cow-pea,	Soja bean,	Bokhara clover (fertilized May, 1889). Sainfoin (fertilized May, 1889).
Plat 17 (fertilized),	Meadow fescue (*Festuca prætensis*),	Meadow fescue,	Meadow fescue.
Plat 18 (unfertilized),	Alsike clover (*Trifolium hybridum*), Medium red clover (*Trifolium pratense*),	Alsike clover, Medium red clover,	Red-cob ensilage corn (fertilized May, 1889).
Plat 19 (fertilized),	Alsike clover, Medium red clover,	Alsike clover, Medium red clover,	Alsike clover. Medium red clover.
Plat 20 (unfertilized),	Mammoth red clover (*Trifolium medium*), Alfalfa or lucerne (*Medicago sativa*),	Mammoth red clover, Alfalfa,	Red-cob ensilage corn (fertilized May, 1889).
Plat 21 (fertilized),	Mammoth red clover, Alfalfa,	Mammoth red clover, Alfalfa,	Corn (variety, Clark).

1889. — The general appearance of the plats seeded down in preceding years with perennial varieties of grasses and of leguminous plants presented some interesting features at the opening of the late season. Some crops had suffered seriously from winter-killing, while others had passed unharmed through the winter. Wherever the growth had suffered, the fact showed itself invariably in the most serious degree upon unfertilized plats.

Kentucky blue-grass, Plat 11 (fertilized), was well preserved; the same circumstance was noticed on Plat 12 (unfertilized).

Perennial rye-grass, plats 13 and 14 (fertilized and unfertilized), was dead in the rows.

Italian rye-grass was fairly preserved in the rows on both plats.

Meadow fescue, Plat 17 (fertilized), was in a healthy and well-preserved condition.

Alsike clover, plats 18 and 19 (unfertilized and fertilized), had suffered somewhat on the unfertilized plat, but was well preserved upon the fertilized plat (19).

Medium red clover, raised on the same plats as the alsike, was in better condition upon the unfertilized plat (18) than the latter, yet fell behind on the fertilized plat (19).

Alfalfa, plats 20 and 21 (unfertilized and fertilized), was almost entirely winter-killed. The same feature was noticeable in regard to mammoth red clover, upon the unfertilized Plat 20, while upon Plat 21 (fertilized) a fair growth was noticed. The plats 15 and 16, which had been used in the preceding season for the production of Soja beans, were ploughed and prepared for seeding; the same course was pursued in regard to the grass and clover plats, where the growth had been seriously winter-killed, — plats 18, 20 and 21.

Plats 12, 14, 16, 18 and 20, which for five preceding years had not been fertilized, were treated, like all fertilized plats in this field, with eighty pounds of fine-ground bones and twenty-seven pounds of muriate of potash per acre.

Plats 15 and 16 were turned to account for the cultivation of Bokhara clover (*Melilotus alba*) and of sainfoin (*Onobrychis sativa*). Each plat was subdivided into two equal parts, and seeded down, one-half with Bokhara clover and the other half with sainfoin, May 8.

Plats 13, 14, 18 and 20 were planted, May 27, with red-cob ensilage corn, a dent variety sent on for trial by Messrs. D. J. Bushnell & Co. of St. Louis. Nine quarts of corn were used for that purpose. Plat 21 was planted on the same day with two and one-half quarts of Clark corn, a flint variety of medium size.

The grasses and clover varieties were kept clean from weeds by the use of the cultivator and the hoe; a similar attention was bestowed upon the corn-bearing plats.

The Kentucky blue-grass, seeded down in 1888, proved to be largely a mixture of other grasses, herd's grass in particular. The grass on both plats was cut for hay June 24. Plat 11 (fertilized) yielded 520 pounds of hay, or 3,921 pounds per acre; Plat 12 (unfertilized) yielded 280 pounds of hay, or 2,111 pounds per acre. The sod was subsequently turned under, and both plats re-seeded with Kentucky blue-grass, September, 1889.

Meadow fescue, Plat 17, began to head out May 30; it bloomed June 4; it was thirty-six inches high when in full blossom. The cutting had to be deferred, on account of rainy weather, to June 20, when it measured forty-four inches in height. The first cut of hay weighed 560 pounds, or 4,422 pounds per acre; the second cut (rowen) of hay, September 4, weighed 290 pounds, or 2,187 pounds per acre. This grass compares well in quality and quantity with herd's grass; seeded down close, it forms a compact, healthy-looking sod.

Bokhara clover, Plat 15, was seeded May 8; it appeared above ground May 16; was eight inches high July 3, and thirty-two inches August 7; it was cut for hay September 9, and yielded at the rate of 3,090 pounds per acre. The second year's growth is usually much heavier; the plant dies out with the end of the second year. The large yield of vegetable matter, in particular during the second year, renders further observation with this plant for feeding purposes advisable.

Sainfoin, Plat 15, was seeded May 8; the young plants appeared above ground May 18; it measured four inches

July 3. The growth of the plant was very slow during the entire season. The land was cleaned from weeds September 24, and the crop left for another year's observation. Whether a cold and wet season caused this slow progress in the growth of this reputed fodder crop, has to be left for the future to decide.

Alsike clover, Plat 19, started up well in May; it was in full bloom June 3, and was cut for hay July 2. The clover hay weighed 155 pounds, or 2,400 pounds per acre.

Medium red clover, Plat 19, began blooming June 17; the crop was cut for hay July 12. The latter weighed 180 pounds, or 2,900 pounds per acre.

In the interest of a due appreciation of the annual yield stated in connection with the above-described grasses and clovers, attention is here once more called to the fact that all were raised in rows, and not broadcast. The rows were, in case of the grasses, for stated reasons, two feet apart, and in case of clovers three feet. The numerical statements regarding their annual yield are therefore mainly of interest as far as relative quantities are concerned. Taking this circumstance into due consideration, it will be conceded that the yield in some instances has been remarkably large; as, for instance, in the case of meadow fescue, — 4,422 pounds of hay in the first cut and 2,187 pounds in the second cut, or 6,609 pounds of hay per acre. On a previous occasion it has been already stated that the cultivation of grasses in drills has been adopted in our experiments, on account of the chances this system of cultivation offers to keep individual varieties of grasses free from foreign growth. The introduction of drill cultivation in connection with the raising of grain crops is deservedly urged upon the attention of farmers, in the interest of clean cultivation.

Red-cob ensilage corn, plats 13, 14, 18 and 20, was planted in drills with nine quarts of seed corn, May 25. The rows were three feet and three inches apart, and the kernels were dropped in the rows from twelve to fourteen inches apart, with from four to six seeds in a place. The entire field was subsequently kept clean from weeds by a frequent use of the cultivator or the hoe, as circumstances advised. The young plants appeared above ground June 3. The crop looked vigorous and handsome throughout the entire season, yet was somewhat behind in its various stages of growth. The entire crop was cut for the silo September 6 and 7, although the ears were not yet as far advanced as desirable to secure the full benefit of the season. Early frosts oblige us to cut our corn crops at the beginning of the month of September. This feature of our local climate advises the selection of early-maturing varieties of corn. The green crop secured from the different plats varied widely in weight, — a result apparently largely due to the particular condition of the soil with reference to temporary available resources of plant food. The majority of plats (14, 18 and 20) had not been fertilized for several preceding years; Plat 13 was the only one, planted with the stated variety of corn, which for years had been fertilized with bone and potash. One year's treatment, spring of 1889, with a corresponding amount of these two manurial substances, did not raise their productiveness to its full capacity.

Plat 13	yielded	5,820 lbs. green fodder corn, or	43,884 lbs. per acre.
“ 14	“	4,755 “ “ “ “	35,853 “ “
“ 18	“	3,230 “ “ “ “	24,354 “ “
“ 20	“	2,560 “ “ “ “	19,302 “ “

Clark corn, Plat 21, was planted on the same date as the former, and treated alike in all particulars; it did well throughout the season; it showed tassels July 19, and was cut for the silo September 7. The crop was more matured than the red-cob ensilage corn, yet was the lowest in weight, — 2,365 pounds per plat, or 17,832 pounds per acre. The main difference in the weight of the crops secured from both varieties of corn does not express their relative food value; yet the difference in that direction is so great that it must be admitted that the Clark corn is not a success as an ensilage corn.

ANALYSES OF CROPS RAISED UPON FIELD B DURING THE SUMMER SEASON OF 1888.

Italian Rye Grass (1888).

	COLLECTED JUNE 29, 1888 IN BLOOM.		COLLECTED JULY 16, 1888, IN SEED.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.30	8.96	8.22	7.38
Dry matter,	90.74	91.04	91.78	92.62
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	7.44	7.50	8.58	6.55
" cellulose,	31.27	32.79	36.90	32.38
" fat,	2.04	1.39	1.90	2.07
" protein (nitrogenous matter),	9.75	7.13	9.53	6.20
Non-nitrogenous extract matter,	49.50	51.19	43.09	52.80
	100.00	100.00	100.00	100.00

Fertilizing Constituents of Italian Rye Grass.

	COLLECTED JUNE 29, 1888. IN BLOOM.		COLLECTED JULY 16, 1888, IN SEED.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.300	8.960	9.204	7.380
Calcium oxide,	.644	.639	.983	1.160
Magnesium oxide,	.357	.316	.328	.284
Ferric oxide,	.045	.042	.065	.130
Sodium oxide,	.151	.463	.795	.395
Potassium oxide (4¼ cts. per lb.),	1.922	1.184	2.086	.940
Phosphoric acid (6 cts. per lb.),	.546	.572	.539	.564
Nitrogen (17 cts. per lb.),	1.415	1.039	1.381	.919
Insoluble matter,	1.922	2.602	2.290	3.507
Valuation per ton,	$7 10	$5 22	$6 24	$4 59

Analyses of Crops raised upon Field B — *Continued.*

Alsike Clover (1888).

	Collected June 21, 1888, in Bloom.		Collected July 18, 1888, in Seed.
	Fertilized.	Unfertilized.	Fertilized.
Moisture at 100° C.,	13.52	13 10	6.08
Dry matter,	86.48	86.90	93.92
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	15 91	9.90	8.26
" cellulose,	26 79	24.03	32.34
" fat,	2.19	1 88	3 07
" protein (nitrogenous matter),	16.48	17 55	14.77
Non-nitrogenous extract matter,	38.63	46.64	41.56
	100.00	100.00	100 00

Fertilizing Constituents of Alsike Clover.

	Collected June 21, 1888, in Bloom.		Collected July 18, 1888, in Seed.
	Fertilized.	Unfertilized.	Fertilized.
Moisture at 100° C.,	13 520	13 100	6 080
Calcium oxide,	2.119	2 608	2 838
Magnesium oxide,	.330	.705	.304
Ferric oxide,	.141	.202	.064
Sodium oxide,	.299	.273	.209
Potassium oxide,	4.308	1.087	2.602
Phosphoric acid,	.716	.704	.496
Nitrogen,	2.280	2.440	2.214
Insoluble matter,	.744	1.102	.420
Valuation per ton,	$12 27	$10 06	$10 34

Medium Red Clover (1888).

[Collected July 6, 1888, in bloom, fertilized.]

Moisture at 100° C.,	6.02
Dry matter,	93.98
	100.00

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Analysis of Dry Matter.

Crude ash,	8.90
" cellulose,	29.97
" fat,	2.62
" protein (nitrogenous matter),	14 63
Non-nitrogenous extract matter,	43 88
	100.00

Fertilizing Constituents of the Above Medium Red Clover.

Moisture at 100° C.,	6.020
Calcium oxide,	1.932
Magnesium oxide,	.423
Ferric oxide,	.064
Sodium oxide,	.201
Potassium oxide,	2.315
Phosphoric acid,	.459
Nitrogen,	2.198
Insoluble matter,	.267
Valuation per ton,	$9 99

Mammoth Red Clover (1888).

	COLLECTED JUNE 21, 1888, IN BLOOM.		COLLECTED JULY 13, 1888, IN SEED.
	Fertilized.	Unfertilized.	Unfertilized.
Moisture at 100° C.,	17.53	9.36	7.34
Dry matter,	82 47	90 64	92 66
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	10.50	10.50	8.53
" cellulose,	33.72	20.16	28.65
" fat,	2.25	1.86	2.25
" protein (nitrogenous matter),	14.69	18.50	14.06
Non-nitrogenous extract matter,	38.84	48.98	46 51
	100.00	100 00	100 00

ANALYSES OF CROPS RAISED UPON FIELD B — *Continued.*

Fertilizing Constituents of Mammoth Red Clover.

	COLLECTED JUNE 21, 1888, IN BLOOM.		COLLECTED JULY 23, 1888, IN SEED.
	Fertilized.	Unfertilized.	Unfertilized.
Moisture at 100° C.,	17.530	9.360	7.340
Calcium oxide,	2.732	3.978	2.712
Magnesium oxide,	.312	.792	.735
Ferric oxide,	.057	.144	.133
Sodium oxide,	.512	.558	.098
Potassium oxide,	2 430	.726	.513
Phosphoric acid,	.504	.704	.421
Nitrogen,	1.938	2.680	2.075
Insoluble matter,	.261	.908	1.168
Valuation per ton,	$9 26	$10 57	$8 00

Alfalfa (1888).

	COLLECTED JUNE 29, 1888, IN BLOOM.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	4.68	4.60
Dry matter,	95.32	95.40
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.97	7.10
" cellulose,	34.39	32 41
" fat,	1.12	1.04
" protein (nitrogenous matter),	16.27	14.41
Non-nitrogenous extract matter,	40.25	45.04
	100.00	100.00

ANALYSES OF CROPS RAISED UPON FIELD B — *Concluded.*

Fertilizing Constituents of Alfalfa.

	COLLECTED JUNE 29, 1888, IN BLOOM.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	4.680	4.600
Calcium oxide,	1.944	2.855
Magnesium oxide,	.279	.513
Ferric oxide,	.050	.070
Sodium oxide,	.079	1.156
Potassium oxide,	2.038	.891
Phosphoric acid,	.556	.645
Nitrogen,	2.481	2.200
Insoluble matter,	.140	.508
Valuation per ton,	$10 84	$9 00

Soja Bean (Entire Plant, Dry).

[Collected Aug. 30, 1888, unfertilized.]

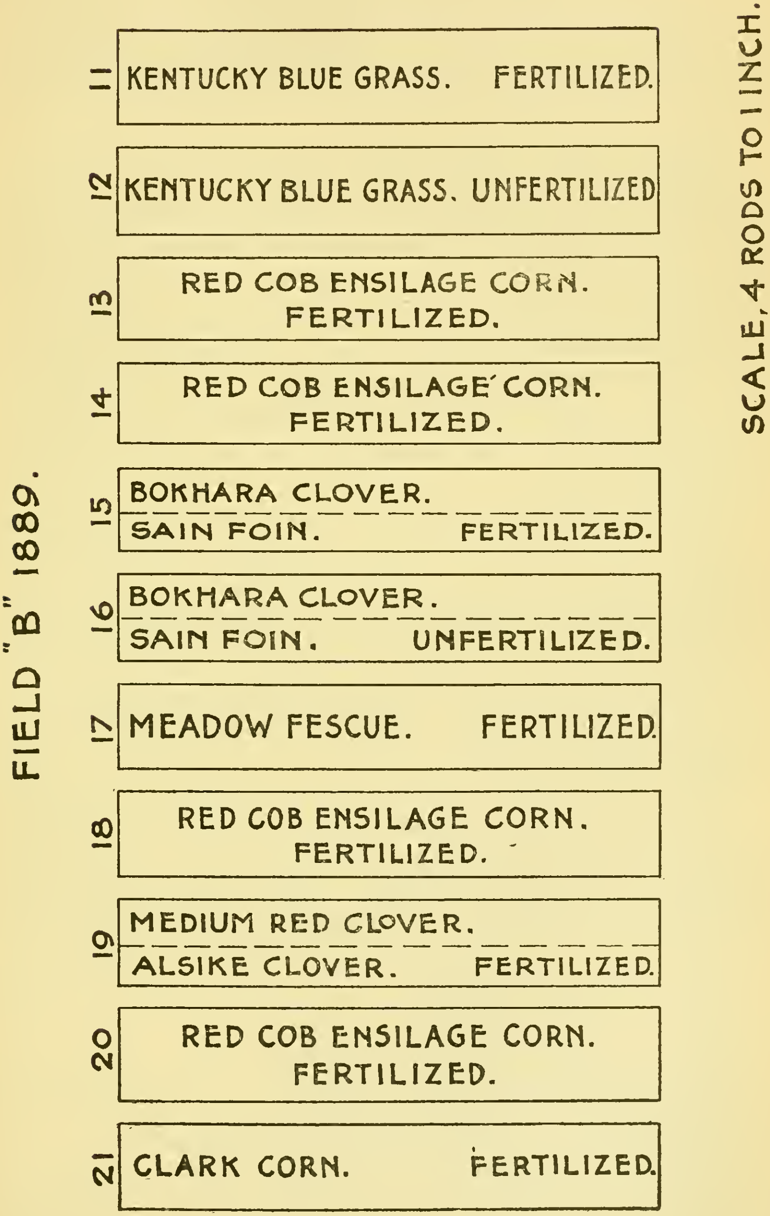
Moisture at 100° C.,	6.12
Dry matter,	93.88
	100.00

Analysis of Dry Matter.

Crude ash,	6.47
" cellulose,	20.76
" fat,	5.62
" protein (nitrogenous matter),	15 87
Non-nitrogenous extract matter,	51.28
	100.00

Fertilizing Constituents of the Above Soja Bean.

Moisture at 100° C ,	6.120
Calcium oxide,	2.770
Magnesium oxide,	1.190
Ferric oxide,	.131
Sodium oxide,	.198
Potassium oxide,	.617
Phosphoric acid,	.753
Nitrogen,	2.380
Insoluble matter,	.967
Valuation per ton,	$9 51


FIELD "B" 1889.

SCALE, 4 RODS TO 1 INCH.

11 KENTUCKY BLUE GRASS. FERTILIZED.
12 KENTUCKY BLUE GRASS. UNFERTILIZED
13 RED COB ENSILAGE CORN. FERTILIZED.
14 RED COB ENSILAGE CORN. FERTILIZED.
15 BOKHARA CLOVER. SAIN FOIN. FERTILIZED.
16 BOKHARA CLOVER. SAIN FOIN. UNFERTILIZED.
17 MEADOW FESCUE. FERTILIZED.
18 RED COB ENSILAGE CORN. FERTILIZED.
19 MEDIUM RED CLOVER. ALSIKE CLOVER. FERTILIZED.
20 RED COB ENSILAGE CORN. FERTILIZED.
21 CLARK CORN. FERTILIZED.

III. EXPERIMENTS WITH FIELD AND GARDEN CROPS.
(FIELDS C AND D, 1889.)

A short description of the work carried on upon these fields during the preceding year, 1888, may serve as an introduction to a brief statement of the course adopted in 1889.

Field C, 1888.— This field comprises an area 328 feet long and 183 feet wide. It was ploughed the previous fall, and again April 26 ; it was harrowed soon after, and fertilized broadcast at the rate of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash per acre. The field is divided into two parts, running from east to west ; they are separated from each other by a passageway three feet wide. The northern half of the field is 70 feet wide and 328 feet long ; the southern half is the same length, but 109 feet wide.

The latter was again subdivided into three equal parts, each 111 by 109 feet, or 11,990 square feet. The east end of this field was planted with a mixture of vetch (*vicia sativa*) and oats (variety Western). The middle division was planted the same day with serradella and the western with Southern cow-pea. Vetch and oats were seeded broadcast, and serradella and Southern cow-pea in drills, three feet three inches apart.

The northern half of Field C was occupied by a series of crops in rows, running north and south, three feet three inches apart, with the exception of the carrots, which were planted in rows fourteen inches apart. The crops were arranged in the following order, beginning at the east end : —

Danvers carrots, ninety rows.
Welcome oats, three rows.
Hairy vetch (*Vicia villosa*), one row.
Small pea (*Lathyrus sativus*), one row.
Sulla (*Hedysarum coronaria*), one row.
Bird's-foot clover (*Lotus corniculatus*), three rows.
Lotus villosus, three rows.
Sweet clover (*Melilotus alba*), three rows.
Early cow-pea, one row.

Teosinte (*Euchlæna luxurians*), two rows.
Flour corn, one row.
Pop-corn, striped rice, one row.
Chinese sugar cane, seven rows.
Early orange cane, fifteen rows.
Early amber cane, fifteen rows.

The seeds of the plants, with the exception of the carrots, serradella, vetch and Southern cow-pea, were sent on by the United States Department of Agriculture. (For details, see sixth annual report, pages 115 to 120.)

Field C, 1889. — The entire area of both divisions of this field was carefully prepared in a similar manner as in the preceding spring. It was ploughed and harrowed April 20, and fertilized broadcast with fine-ground bone and muriate of potash, at the rate of six hundred pounds of the former and two hundred pounds of the latter. The entire southern half of the field was planted with roots, while the northern half was used for raising a variety of fodder and garden crops. The majority of the seeds used in this connection were sent on by the United States Department of Agriculture; others came from parties more or less directly interested in the particular variety sent on for trial; some were bought of reliable parties. Most of these seeds were planted merely for the purpose of studying their particular degree of adaptation to our climate and soil, to secure suitable material for analysis, and to ascertain their relative proportion of essential nutritive constituents. As this part of our work requires exceptional accommodation for analytical work, it has to be largely deferred to a more favorable part of the year. This circumstance must serve as our excuse for publishing some analyses of the crops raised in 1888 for the first time on the present occasion.

Description of the Principal Crops raised on the Southern Division of Field C, beginning at the West End.

American ruta-baga turnips of Delano Moore, Presque Isle, Me., two rows, 109 feet long and 2 feet apart, were planted May 3. The young plants appeared above ground May 11; they were thinned out in the rows to eight inches of space between them, July 1, and subsequently kept clean from weeds by a periodical use of the cultivator and the hoe. A blight which appeared during the first week of August on the leaves did considerable injury to the earlier foliage; the later leaves suffered less seriously. The crop was harvested October 22; the roots weighed 170 pounds. Photographs representing fair specimens of the roots will be found farther on. An analysis stating the composition of a medium-sized root is reported at the close of this chapter.

Lane's Sugar Beet. — The seeds used in this case were sent on by C. H. Lane of Middlebury, Vt. The area occupied by the plant measured 1,090 square feet. The seeds were planted in rows two feet apart, May 3; the young plants appeared above ground May 11; they were thinned out in the rows to six inches space between them, June 18, and kept clean from weeds by cultivator and hoe in the same manner as the previously described crop. The first growth of leaves suffered seriously from a blight, the later leaves were entirely free from blight, and made a vigorous growth. The crop was harvested October 19; it weighed 610 pounds, without the leaves. A photograph of different sizes of the roots, and an analysis stating the composition of a medium-sized root, will be found farther on.

Saxony Sugar Beet. — This crop occupied an area of 15,587 square feet. The seed was sown in rows two feet apart, to admit the use of a one-horse cultivator, May 3. The seeding was heavy; five and one-half ounces of seed were used. The young plants were thinned out and treated like the previously stated crop. The unfavorable, cold, wet weather during the fore part of the summer season affected this crop in a similar way as the preceding root crops. Insects and a blight destroyed almost entirely the first leaf growth. The later leaves were vigorous, and apparently free from blight. The roots were harvested October 19; they weighed 6,450 pounds, or nine tons per acre, which is about one-half an average crop. Photographs and a chemical analysis accompany these statements.

Carrots, Danvers. — The land occupied by this crop measured 18,420 square feet; the seed was sown in rows, leaving fourteen inches of space between, May 13; fourteen ounces of seed were used for that purpose. The plants came up May 21; they were thinned out by hand in the rows from two to three inches apart. The crop was kept clean by weeding with the hand and the hoe. The leaves suffered somewhat from blight during the earlier part of the month of August. The roots were harvested October 17; they weighed 11,390 pounds, or 13⅓ tons per acre.

The serious influence of an unfavorable season on the yield of the root crops has been a marked one. The roots were much smaller than in preceding years; this circumstance applies with particular force to the different varieties of sugar beets on trial. The crops have fallen behind in these cases more than fifty per cent. of a fair average yield. The yield of carrots is one-third less than that obtained in preceding years.

Statement of Crops raised on the Northern Division of Field C.

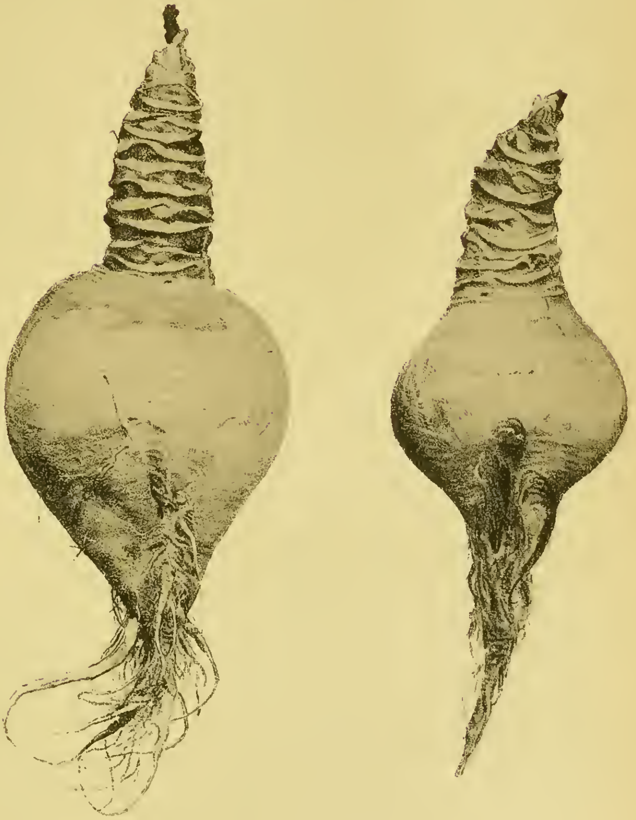
This section of Field C is 70 feet wide and 328 feet long, and laid out in rows from two to three feet apart, as circumstances may advise. Most of the crops raised here are merely on trial, to study their general adaptation to our soil and climate; a few rows represent in most instances the extent of the area occupied by each of them. In many instances merely a sufficient amount is raised to secure suitable samples for chemical examination. Wherever the results in the field and in the laboratory are encouraging, as far as fodder crops new to our section of the country are concerned, larger fields will be devoted subsequently, to test their respective agricultural merits on a becoming scale.

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crops (aside from the products of pastures and meadows), — the fodder corn and corn stover.

A more detailed discussion of this important question may be found in our fifth annual report, page 88, and sixth annual report, page 115.

The crops were arranged in the following order, beginning at the west end : —

Erfurt earliest cauliflower, two rows.
Early snowball cauliflower, two rows.
Haines No. 64 tomato, two rows.
Honduras sorghum, seven rows.
New orange sorghum, seven rows.
Kansas orange sorghum, seven rows.
Price's new hybrid sorghum, seven rows.
Early Tennessee sorghum, seven rows.
Bokhara clover (*Melilotus alba*), three rows.
Bokhara clover (*Melilotus cæruleus*), three rows.
Lotus villosus, two rows.
Pyrethrum roseum, one row.
Sulla (*Hedysarum coronaria*), one row.
Pease, one row.
Dwarf Lima beans, one-half row.
Early cow-pea, one and one-half rows.
Black soja bean, five rows.
Blue lupine, two rows.
Cow-pea, three rows.
Horse bean, three rows.
Japan clover (*Lespideza striata*), five rows.
Chapman honey plant, three rows.
New Japanese buckwheat, seventeen rows.
Common barley, fifteen rows.
Hulless black barley, fifteen rows.



American Ruta Baga Turnips.

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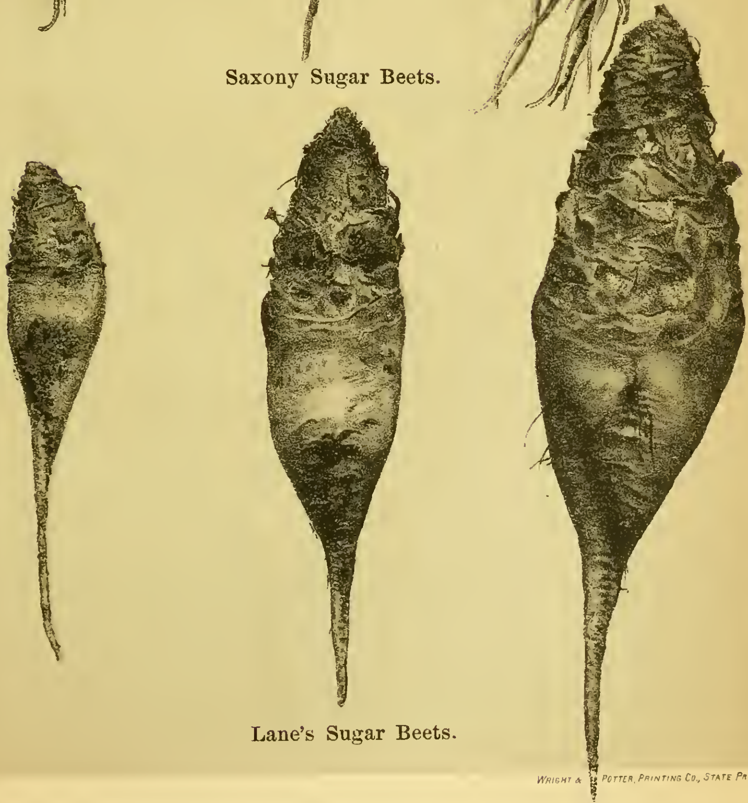
Saxony Sugar Beets.



Lane's Sugar Beets.

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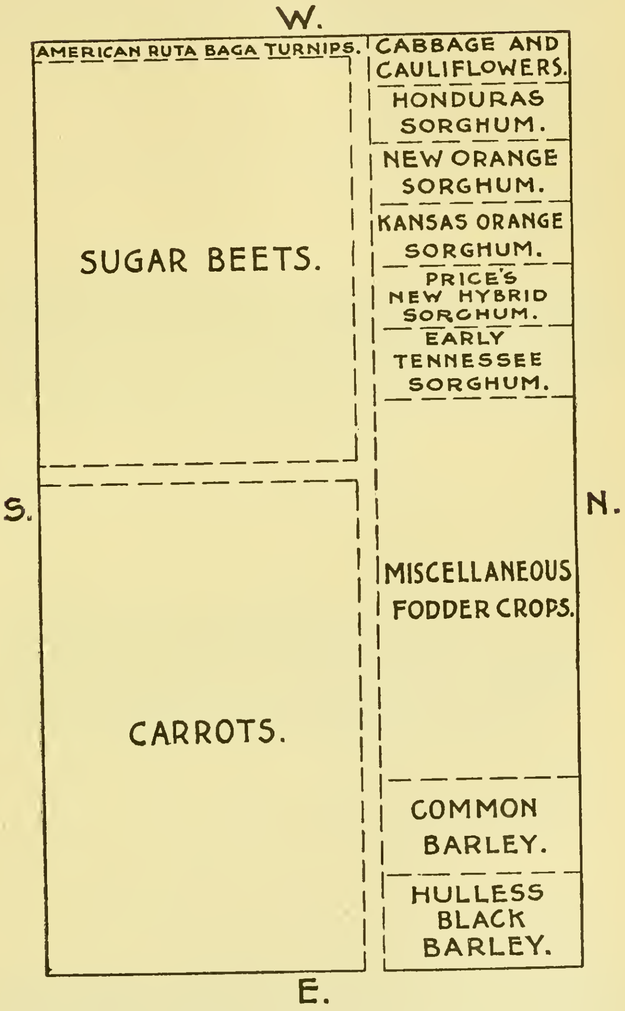
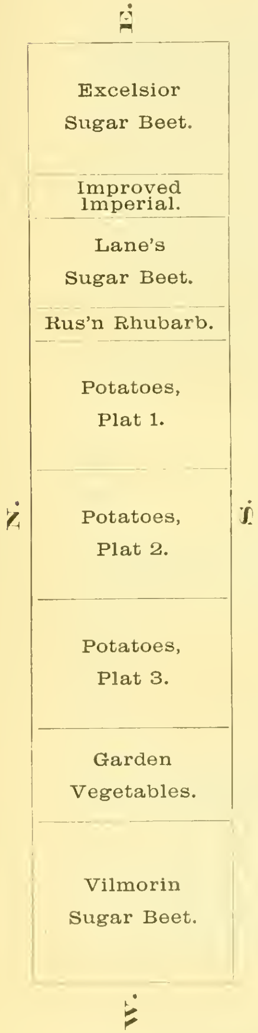
FIELD "C" 1889.


W.
AMERICAN RUTA BAGA TURNIPS.
CABBAGE AND CAULIFLOWERS.
HONDURAS SORGHUM.
NEW ORANGE SORGHUM.
KANSAS ORANGE SORGHUM.
PRICE'S NEW HYBRID SORGHUM.
EARLY TENNESSEE SORGHUM.
SUGAR BEETS.
S.
N.
MISCELLANEOUS FODDER CROPS.
CARROTS.
COMMON BARLEY.
HULLESS BLACK BARLEY.
E.

SCALE, 4 RODS TO 1 INCH.

Field D, 1888. — This field is 328 feet long and 70 feet wide, covering an area of 22,960 square feet. It has been used during previous years for the raising of a variety of garden and field crops, on a larger or smaller scale. The soil has been usually ploughed late in the fall and early in the succeeding spring. The manure has been applied in every instance early in the spring, after ploughing, and subsequently slightly harrowed under. With the exception of the potato plats used for studying the causes of the scab on potatoes, but one fertilizer, consisting of fine-ground bones with muriate of potash, six hundred pounds of the former and two hundred pounds of the latter per acre, has been used upon this field. The distribution of the crops raised during the year 1888 may be seen from the accompanying sketch. Some analyses of crops raised during that year are for stated reasons published farther on for the first time, in connection with analyses made of crops raised during the present year.

FIELD D, 1888.*

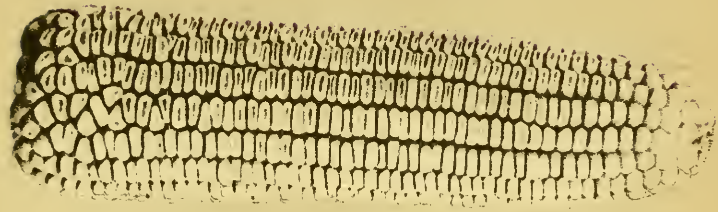


* Scale, 4 rods to 1 inch.

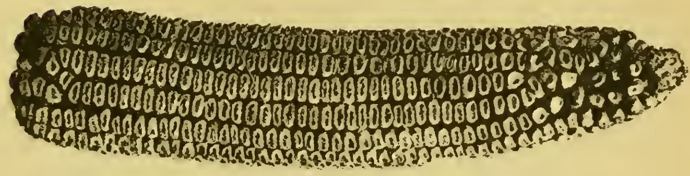
1889. — The preparation of the soil, as well as the system of manuring, was in all its details the same as in the preceding years. The crops were planted in rows, and kept clean by the timely use of the cultivator and the hoe. They were arranged in the following order, beginning at the west end of the field : —

Red-cob Ensilage Corn. — The seed was sent on, with a request for a trial, by D. I. Bushnell & Co., St. Louis, Mo. An area of 5,460 square feet was assigned in this field for our observation. The seed was planted May 7 ; the young plants appeared above ground in

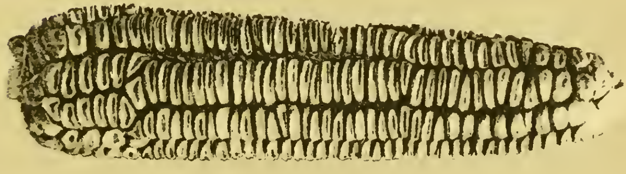
EXPERIMENTS WITH FIELD AND GARDEN CROPS.



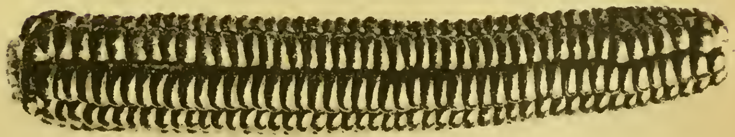
1. Red Cob Ensilage Corn.



2. Pride of the North Corn.



3. Minnesota King Corn.



4. Clark Corn.

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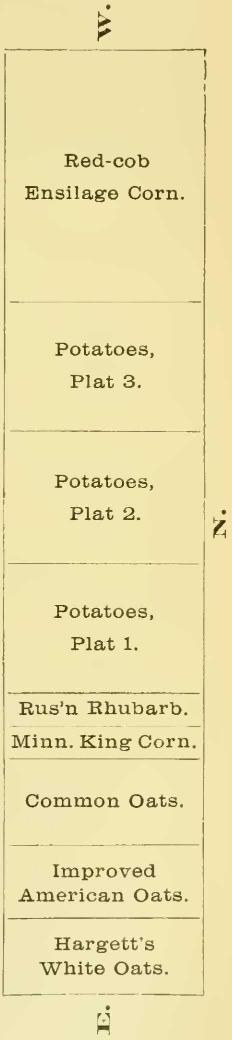
May; tassels were first noticed July 30. The growth measured at this time 70 inches in height; it was 105 inches high at the appearance of silk. The field looked extremely vigorous and handsome at this stage of the growth, — middle of August. The leaves died, however, soon, largely beginning at the lower end of the stalks. Most of the foliage up to the middle of the stalks was dead before the kernels began to glaze over. The plants measured 10½ feet in height when cut, October 2. The ears were at this late date not yet fully matured; they were also to a considerable degree imperfect in their general development. We obtained 475 pounds of ears and 2,550 pounds of stover.

FIELD D, 1889.*



* Scale, 4 rods to 1 inch.

The exceptionally cool and wet weather during the months of July and August has no doubt largely contributed to the unsatisfactory termination of our trial for a matured crop. Late maturing varieties of corn offer but little chance with us for a successful curing. Our trial for ensilage has been referred to in some preceding pages (Field B). The general character of a well-matured ear of this handsome corn may be judged from a description and photograph of an ear sent on to the station, which occur farther on.

Potatoes (Beauty of Hebron). — Three plats for several years assigned to this crop to study the causes of scab were prepared and manured in exactly the same manner as in previous years. They were planted with healthy tubers, May 1; the young crop showed itself pretty uniformly over the entire field, May 16. A blight appeared at the close of the month of July; it spread so rapidly that it killed within a week the entire vines. The crop was harvested without delay, yet proved a total failure; the tubers, almost without an exception, were full of scab and soon rotted.

The experiments regarding the cause of scab on potatoes, which for several years past have been carried on upon this part of our field, have been transferred to Field E; they have been placed, since the beginning of 1889, under the special direction of Prof. J. E. Humphrey. His elaborated report regarding his studies of scab and other plant diseases, which forms a part of this report, cannot fail to engage the attention of all parties interested in the subject discussed.

Minnesota King Corn. — Two samples were sent on by Northrup, Braslan & Goodwin of Minneapolis, Minn. Two rows were planted May 14; the plants reached a height of 66 inches and matured during the first week of September. They compared well with other medium-sized varieties current in our vicinity; no special merits were noticed. The general character of the corn may be judged from a short description and photograph which may be found farther on.

Oats. — Three varieties were planted. The seeds of two varieties — "Hargett's White" (Seizure) and "Improved American" — were sent by the United States Department of Agriculture; the third variety, commonly called "Connecticut Valley Oats," was secured from a farmer in our vicinity. The latter, one of the most prominent home varieties of oats, was included in our observation for the purpose of comparing the individual merits, if any, of the different varieties on trial, as far as practicable under corresponding circumstances. The seeds were planted, each fifteen rows, two feet apart. The main difference in the advancing growth consisted in a deep-green color of the Improved American. The latter exceeded the other varieties by three inches in height at the close of the season. All matured about the same time, and were cut on the same day, July 19. When harvested, July 23, the entire crop of the Hargett's White weighed 360 pounds; of the home variety, weighed 350 pounds; of the Improved American, weighed 390 pounds.

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Russian Rhubarb Roots.

Most of our grain crops suffered more or less from smut. The season was evidently not favorable for comparative trial of grain crops.

Russian Rhubarb. — Some years ago a small sample of seeds of this plant was sent on to the station by the Secretary of the American Retail Druggist Association, with the request to experiment with them upon our fields. The seed was represented as genuine by an officer of the Russian government, who procured it for the association. Several plants raised from this seed have been for a number of years cultivated very successfully on our ground. Well-matured seed has been collected every year, and some of it was sown two years ago. Quite a number of roots have been collected for trial by druggists. Parties interested in the question of their fitness for medicinal purposes can secure a specimen for trial, if early applied for. An attempt has been made to give a correct picture of the roots in different positions by the photographs accompanying this chapter. Photographs of the same kind of crop have in every instance been taken at equal distance from the camera, that their relative sizes might be observed.

Description of the Ears of Corn illustrated by the Following Photographs.

1. Red-cob ensilage corn, a dent variety mentioned in this chapter.
2. Pride of the North corn, a dent variety largely grown upon the station grounds.
3. Minnesota king corn, a dent corn mentioned in this chapter.
4. Clark corn, a flint corn which has served for our observations on Field A.

	Number of Rows.	Number of Kernels per Row.	Length of Ear (Inches).	Weight of Ear (Grams).*	Weight of Kernels (Grams).	Weight of Cob (Grams).	Ratio of Cob to Kernels.	Average weight of Kernels (Grams).
1, . . .	16	54	8½	396	339	57	1 : 5.95	.97
2, . . .	16	46	8	205	178	27	1 : 6.59	.25
3, . . .	8	44	7½	157	110	47	1 : 2.34	.31
4, . . .	8	48	8½	159	128	31	1 : 4.13	.336

* One ounce equals about thirty grams.

Teosinte (Euchlæna luxurians).

[Collected Sept. 7, 1888, in full bloom.]

	Per Cent.
Moisture at 100° C.,	6.06
Dry matter,	93.94
	100.00

Analysis of Dry Matter.

Crude ash,	6.95
" cellulose,	28.88
" fat,	1.28
" protein (nitrogenous matter),	9.71
Non-nitrogenous extract matter,	53.18
	100.00

In green material, moisture 89.42 per cent.; dry matter, 10.58 per cent.

Fertilizing Constituents of Teosinte.

Moisture at 100° C.,	6.060
Calcium oxide,	1.597
Magnesium oxide,	.458
Ferric oxide,	.021
Sodium oxide,	.109
Potassium oxide (4¼ cents per pound),	3.696
Phosphoric acid (6 cents per pound),	.546
Nitrogen (17 cents per pound),	1.460
Insoluble matter,	.315
Valuation per ton,	$8 76

Lotus villosus (Second Year's Growth).

[Collected June 21, 1889, in full bloom.]

	Per Cent.
Moisture at 100° C.,	10.68
Dry matter,	89.32
	100.00

Analysis of Dry Matter.

Crude ash,	8.23
" cellulose,	24.48
" fat,	3.00
" protein (nitrogenous matter),	13.49
Non-nitrogenous extract matter,	50.80
	100.00

In green material, moisture 83.37 per cent.; dry matter, 16.63 per cent.

Lotus villosus (First Year's Growth).

[Collected Sept. 7, 1888, blooming.]

	Per Cent.
Moisture at 100° C.,	12.36
Dry matter,	87.64
	100.00

Analysis of Dry Matter.

Crude ash,	8.30
" cellulose,	15.07
" fat,	2.69
" protein (nitrogenous matter),	16.12
Non-nitrogenous extract matter,	57.82
	100.00

In green material, moisture 88.63 per cent.; dry matter, 11.37 per cent.

Fertilizing Constituents of Lotus villosus.

Moisture at 100° C.,	12.360
Calcium oxide,	2.861
Magnesium oxide,	.615
Ferric oxide,	.148
Sodium oxide,	.633
Potassium oxide (4¼ cents per pound),	1.550
Phosphoric acid (6 cents per pound),	.500
Nitrogen (17 cents per pound),	2.259
Insoluble matter,	1.053
Valuation per ton,	$9 60

Sulla (Hedysarum coronaria).

[Collected Oct. 3, 1888, at the close of the period of blooming.]

	Per Cent.
Moisture at 100° C.,	10.46
Dry matter,	89.54
	100.00

Analysis of Dry Matter.

Crude ash,	8.77
" cellulose,	12.38
" fat,	3.16
" protein (nitrogenous matter),	17.03
Non-nitrogenous extract matter,	58.66
	100.00

In green material, moisture 74.21 per cent.; dry matter, 25.79 per cent.

Fertilizing Constituents of Sulla.

	Per Cent.
Moisture at 100° C.,	10.460
Calcium oxide,	2.791
Magnesium oxide,	.378
Ferric oxide,	.147
Sodium oxide,	.362
Potassium oxide (4¼ cents per pound),	1.872
Phosphoric acid (6 cents per pound),	.424
Nitrogen (17 cents per pound),	2.441
Insoluble matter,	.987
Valuation per ton,	$10 40

Hairy Vetch (Vicia villosa).

[Collected Sept. 3, 1888, blooming.]

	Per Cent.
Moisture at 100° C.,	7.44
Dry matter,	92 56
	100.00

Analysis of Dry Matter.

Crude ash,	8.37
" cellulose,	31.88
" fat,	1.22
" protein (nitrogenous matter),	19.58
Non-nitrogenous extract matter,	38.95
	100 00

In green material, moisture 78.01 per cent ; dry matter, 21 99 per cent.

Bokhara or Sweet Clover (Melilotus alba).

[Collected Oct. 3, 1888, at the close of the period of blooming.]

	Per Cent.
Moisture at 100° C.,	6.36
Dry matter,	93.64
	100.00

Analysis of Dry Matter.

Crude ash,	6.90
" cellulose,	28.08
" fat,	1.85
" protein (nitrogenous matter),	11.81
Non-nitrogenous extract matter,	51.36
	100.00

In green material, moisture 76.52 per cent.; dry matter, 23.48 per cent.

Fertilizing Constituents of Bokhara Clover.

	Per Cent.
Moisture at 100° C.,	6.360
Calcium oxide,	1.938
Magnesium oxide,	.373
Ferric oxide,	.028
Sodium oxide,	.077
Potassium oxide (4¼ cents per pound),	1.673
Phosphoric acid (6 cents per pound),	.436
Nitrogen (17 cents per pound),	1,770
Insoluble matter,	.013
Valuation per ton,	$7 96

Melilotus cœruleus.

[Collected Aug. 6, 1889, somewhat past blooming.]

	Per Cent.
Moisture at 100° C.,	8.22
Dry matter,	91.78
	100.00

Analysis of Dry Matter.

Crude ash,	14.87
" cellulose,	27.17
" fat,	1.67
" protein (nitrogenous matter),	13.07
Non-nitrogenous extract matter,	43.22
	100 00

Fertilizing Constituents of Melilotus cœruleus.

Moisture at 100° C.,	8.220
Calcium oxide,	1.449
Magnesium oxide,	.260
Ferric oxide,	.349
Sodium oxide,	.270
Potassium oxide (4¼ cents per pound),	2.796
Phosphoric acid (6 cents per pound),	.544
Nitrogen (17 cents per pound),	1.919
Insoluble matter,	4.008
Valuation per ton,	$9 55

Danvers Carrots.

[Grown on Field C, 1888.]

	Per Cent.
Moisture at 100° C.,	90.05
Dry matter,	9.95
	100.00

Analysis of Dry Matter.

	Per Cent.
Crude ash,	8.28
" cellulose,	10.20
" fat,	1.67
" protein (nitrogenous matter),	7.98
Non-nitrogenous extract matter,	71.81
	100.00

Nutritive ratio, 1 : 9.17.

Carrot Tops (Danvers).

[Collected Oct. 31, 1889, two weeks after harvesting.]

	Per Cent.
Moisture at 100° C.,	9.76
Dry matter,	90.24
	100.00

Analysis of Dry Matter.

Crude ash,	13.87
" cellulose,	13.61
" fat,	2.01
" protein (nitrogenous matter),	20.12
Non-nitrogenous extract matter,	50.39
	100.00

In green material, moisture, 76.79 per cent.; dry matter, 23.21 per cent.

Sugar Tests of Sorghum (1889).

[Per Cent.]

	Moisture at 100° C.	Glucose.	Sucrose.	Total Sugar.
Early Tennessee (over-ripe),	77.43	1.79	3.21	5.00
Price's New Hybrid (ripe),	77.80	2.92	3.78	6.70
Kansas Orange (green),	80.67	2.38	3.63	6.01
New Orange (green),	78.30	2.96	3.85	6.81
Honduras (green),	77.55	3.08	4.01	7.09

Beets, Field D (1888).

[I. Excelsior Sugar Beet; II. Improved Imperial; (?) III. Vilmorin Sugar Beet.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	86.95	90.60	86.73
Dry matter,	13.05	9.40	13.27
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	3.21	10.09	5.70
" cellulose,	5.83	7.83	4.82
" fat,	.72	1.80	.73
" protein (nitrogenous matter),	8.74	12.78	8.45
Non-nitrogenous extract matter,	81.50	67.50	80.30
	100.00	100.00	100.00
Sugar,	9.84	3.45	7.24

Fertilizing Constituents of the Above Beets.

	Per Cent.	
	II.	III.
Moisture at 100° C.,	90.600	86.730
Calcium oxide,	.045	.056
Magnesium oxide,	.030	.037
Ferric oxide,	.005	.009
Sodium oxide,	.104	.170
Potassium oxide,	.462	.170
Phosphoric acid,	.086	.028
Nitrogen,	.192	.181
Insoluble matter,	.015	.090
Valuation per ton,	$1 14	$0 79

Beets, Field D (1888).

[IV. Lane's Sugar Beet; V. New Market Gardener Beet; VI. Eclipse Beet; VII. Osborn's Selected Beet.]

	Per Cent.			
	IV.	V.	VI.	VII
Moisture at 100° C.,	84.56	89.65	90 25	88.80
Dry matter,	15.44	10.33	9.75	11.20
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	6.87	7.21	9.77	7.87
" cellulose,	6.17	7.56	7.22	6.71
" fat,	.66	.59	.74	.64
" protein (nitrogenous matter),	10.63	14.29	15.40	14.46
Non-nitrogenous extract matter,	75.67	70.35	66.87	70 32
	100.00	100.00	100.00	100.00

Fertilizing Constituents of the Above Beets.

	Per Cent.		
	V.	VI.	VII.
Moisture at 100° C.,	89.650	90.250	88.800
Calcium oxide,	.032	.044	.064
Magnesium oxide,	.022	.032	.028
Ferric oxide,	.003	.005	.002
Sodium oxide,	.060	.110	.156
Potassium oxide,	.481	.467	.313
Phosphoric acid,	.085	.091	.069
Nitrogen,	.236	.240	.259
Insoluble matter,	.009	.016	.010
Valuation per ton,	$1 41	$1 33	$1 23

Determination of Albuminoid Nitrogen (1888).

	Per Cent. in Dry Matter.		
	Albuminoid Nitrogen.	Non-albuminoid Nitrogen.	Total Nitrogen.
Root, No. 1, ...	.58	.82	1.40
" 2, ...	.85	1.19	2.04
" 3, ...	.50	.85	1.35
" 4, ...	.67	1.03	1.70
" 5, ...	.76	1.53	2.29
" 6, ...	.84	1.63	2.47
" 7, ...	.78	1.53	2.31

Potatoes (1887).

[I. Polaris, healthy tubers; II. Beauty of Hebron, healthy tubers; III. Beauty of Hebron, healthy tubers; IV. Beauty of Hebron, scabby tubers.]

	Per Cent.			
	I.	II.	III.	IV.
Original moisture, ...	80.20	80.73	81.53	82.15
Original dry matter, . . .	19.80	19.27	18.47	17.85
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash, ...	5.17	5.17	6.27	6.35
" cellulose, ...	1.91	3.32	3.22	3.55
" fat, ...	0.62	0.57	0.52	0.58
" protein (nitrogenous matter),	10.74	9.58	9.73	10.70
Non-nitrogenous extract matter, .	81.56	81.36	80.26	78.80
	100.00	100.00	100.00	100.00
Albuminoid nitrogen, in dry matter,	.91	.73	.77	.92
Non-albuminoid nitrogen, in dry matter, ...	.80	.80	.79	.79
Total nitrogen, in dry matter, .	1.71	1.53	1.56	1.71

Tabular Statement, showing the Loss in Weight, by Evaporation of Moisture, of Two Potatoes (Beauty of Hebron) kept in a Dry Cellar.

[Weight of potatoes Sept. 13, 1887: No. 1, 108.1210 grams; No. 2, 90.5225 grams.]

DATE OF WEIGHING.	PER CENT. OF ORIGINAL WEIGHT LOST SINCE PRECEDING WEIGHING.		PER CENT. OF ORIGINAL WEIGHT LOST SINCE SEPT. 13, 1887.	
	Potato No. 1.	Potato No. 2.	Potato No. 1.	Potato No. 2.
1887.				
September 26, . . .	1.43	1.43	1.43	1.43
October 10, . . .	.74	.72	2.17	2.15
October 24, . . .	.67	.66	2.84	2.81
November 7, . . .	.55	.53	3.39	3.32
November 21, . . .	.50	.48	3.89	3.80
December 5, . . .	.52	.51	4.41	4.31
December 19, . . .	.55	.52	4.96	4.83
1888.				
January 2, . . .	.55	.53	5.51	5.36
January 16, . . .	.66	.68	6.17	6.04
January 30, . . .	.66	.70	6.83	6.74
February 13, . . .	.89	.93	7.72	7.67
February 27, . . .	1.47	1.41	9.19	9.08
March 12, . . .	1.71	1.78	10.90	10.86
March 28, . . .	2.23	2.20	13 13	13.06
April 9, . . .	2.01	1.88	15.14	14.94

Both potatoes began to sprout Jan. 7, 1888.

American Ruta-baga Turnips (1889).

	Per Cent.
Moisture at 100° C.,	91.75
Dry matter,	8.25
	100.00

Analysis of Dry Matter.

Crude ash,	11.89
" cellulose,	13.12
" fat,	1.26
" protein (nitrogenous matter),	11.46
Non-nitrogenous extract matter,	62.27
	100.00

Fertilizing Constituents of American Ruta-baga Turnips.

Moisture at 100° C.,	91.750
Calcium oxide,	.083
Magnesium oxide,	.030
Ferric oxide,	.005
Sodium oxide,	.009
Potassium oxide,	.468
Phosphoric acid,	.106
Nitrogen,	.151
Insoluble matter,	.015
Valuation per ton,	$1 04

Lane's Sugar Beet (Field C, 1889).

	Per Cent.
Moisture at 100° C.,	90.13
Dry matter,	9.87
	100.00

Analysis of Dry Matter.

Crude ash,	14.54
" cellulose,	9.69
" fat,	.83
" protein (nitrogenous matter),	13.01
Non-nitrogenous extract matter,	61.93
	100.00

Fertilizing Constituents of Lane's Sugar Beet.

Moisture at 100° C.,	90.130
Calcium oxide,	.062
Magnesium oxide,	.043
Ferric oxide,	.007
Sodium oxide,	.006
Potassium oxide,	.720
Phosphoric acid,	.134
Nitrogen,	.205
Insoluble matter,	.038
Valuation per ton,	$1 47

Saxony Sugar Beet (Field C, 1889).

	Per Cent.
Moisture at 100° C.,	88.38
Dry matter,	11.62
	100.00

Analysis of Dry Matter.

Crude ash,	9.14
" cellulose,	6.70
" fat,	.59
" protein (nitrogenous matter),	10.06
Non-nitrogenous extract matter,	73.51
	100.00

Fertilizing Constituents of Saxony Sugar Beet.

Moisture at 100° C.,	88.380
Calcium oxide,	.052
Magnesium oxide,	.044
Ferric oxide,	.009
Sodium oxide,	.004
Potassium oxide,	.617
Phosphoric acid,	.103
Nitrogen,	.187
Insoluble matter,	.022
Valuation per ton,	$1 28

IV. EXPERIMENTS WITH GREEN CROPS FOR SUMMER FEED OF MILCH COWS. (FIELD F.)

The field selected for the raising of green fodder crops for experiments with milch cows (see second feeding experiment, page 48 of this report), had been used for a series of years as a meadow for the production of hay. During the fall of 1887, a piece of land, 300 feet long and 137 feet wide, was ploughed, and the succeeding spring, 1888, after a proper mechanical condition was secured, seeded down with Hungarian grass. After this crop was removed into a silo, the soil was turned, and left in that state for the following year.

1889. — In working out our plans for future experiments upon this field, it was decided to turn the still existing resources of available plant food to account for the raising of Southern cow-peas, serradella, and a mixture of vetch and oats. This decision was made for the following reasons: these crops had given much satisfaction in preceding years, when fed as green fodder to milch cows; they promised, judging from our own experience in adjoining fields, a fair yield when following grass and corn without any use of manure; and they would each reach in a desired succession a stage of growth best adapted for their profitable use as green fodder. The field was ploughed and harrowed early in the season (April, 1889), and subsequently subdivided into three equal parts, 300 feet long and 43 feet wide, with four feet unoccupied space between the plats (see sketch, Field F).

The plat along the north side of the field, 12,900 square feet, was seeded broadcast with twenty-five pounds each of vetch and oats, April 26.

The middle subdivision was sown in drills three feet apart, with eleven pounds of serradella seed. May 8.

The plat along the south side of the field was sown in drills three feet apart, with twenty-five pounds of Southern cow-peas (Clay variety), April 8.

Vetch and Oats. — The oats appeared first above ground; the vetch followed, May 6. The crop was eleven inches high, June 11; it measured twenty-five inches, June 19. The oats began to head out, June 24, and the vetch to bloom, June 25; the entire growth was, on an average, thirty inches high, June 28, when the cutting for the daily feed began. The last of the crop was cut July 17; it had reached a height of forty inches. The average moisture of the green fodder for the entire period was 78.26 per cent., which makes the solid vegetable matter 21.74 per cent. The entire yield of the green crop was 5,440 pounds, or 8½ tons per acre. This result is not as good, as far as quantity is concerned, as that secured during the preceding year, when a mixture of 25 pounds of vetch and 50 pounds of oats were used as seed; the rate of yield per acre in that year was 9½ tons of green fodder. The area occupied by vetch and oats was not large enough to answer fully our purpose, to cover the time until the cow-pea is fit to be used advantageously. We shall hereafter double the area, and seed one-half down, as we did before, towards the close of April, and the other half from two to three weeks later.

Serradella. — The young plants were out May 16. The crop was kept clean with the cultivator and hoe. It is a peculiar feature of this crop, that its growth is very slow until it begins to bloom, when it rapidly branches out, and causes finally a compact, bulky green mass, filling out completely the three feet of space between the rows. The seed was sown, May 8; the plants appeared above ground, May 16; they were but one inch high, June 11; two inches, June 19; two and one-half inches, June 26; and four inches, July 3; began blooming, July 6; ten inches high, July 24; began spreading, July 31; reached thirteen inches in height, August 21. The first feed was cut September 11, when it formed a dense mass, several feet wide; the last feed was cut September 27. The green crop harvested amounted to 8,350 pounds, or 13½ tons per acre. The average moisture was 83.65 per cent., and the solid vegetable matter 16.35 per cent.

Southern Cow-pea. — The young plants were seen six days after planting. The crop was cultivated and kept clean in common with the preceding one; its leaves were slightly injured by frost, May 29. The growth was three inches high, June 11; five and one-half inches, June 26; eight inches, July 3; seventeen inches, July 17; twenty-four inches, August 21, when blossoms appeared. The first cut for fodder was made September 1, and the last, September 10. The entire yield of green fodder amounted to 6,125 pounds, or 10 tons per acre. The average moisture of the crop when fed was 83.07 per cent., leaving, for the solid vegetable matter, 16.93 per cent. The frequent rains during the late summer and the autumn have apparently favored an increase in the yield of green fodder. Whether their composition has suffered, will be learned from a comparison of our analyses of past years.

The general characteristics of the crops above mentioned have been stated in previous reports, and their good services in the dairy are confirmed by our own observations. We can only repeat in this connection the views advanced in previous reports.

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business; for it secures a liberal supply of healthy, nutritious fodder, at the same time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, make it but judicious to consider seriously the means which promise not only to increase, but also to cheapen, the products of the dairy.

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this basis as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen-containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

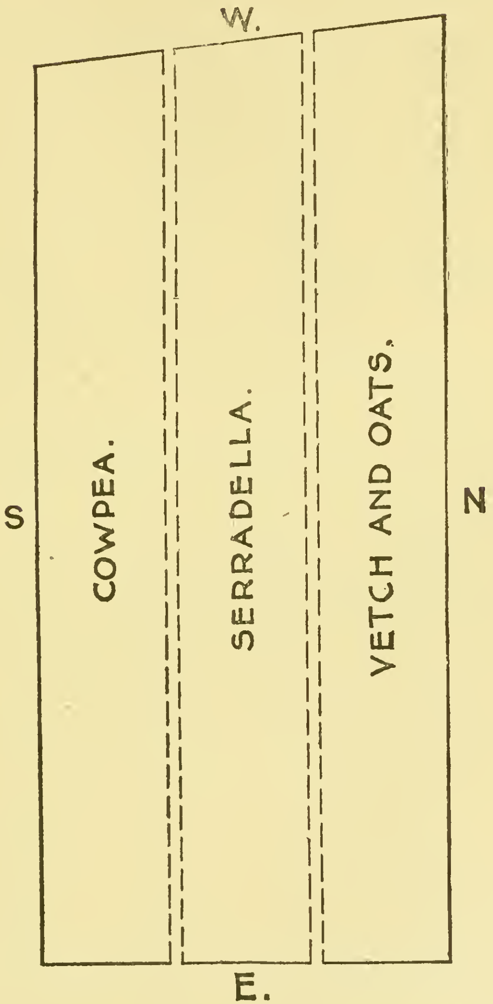
Our prominent fodder crops may be classified, in regard to the relative proportion of their nitrogenous organic food constituents to their non-nitrogenous organic food constituents (nutritive ratio), in the following order: —

1. Leguminous plants, clovers, vetches, etc., . .	1 : 2.2 to 1 : 4.5
2. Grasses, ...	1 : 5.0 to 1 : 8.0
3. Green corn, roots and tubers, ...	1 : 6.0 to 1 : 15.0

A liberal introduction of reputed forage crops into farm operations has everywhere, in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, pease, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the economical systems of rotations, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops. Although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

FIELD "F" 1889.


W.
S
COWPEA.
SERRADELLA.
VETCH AND OATS.
N
E.

SCALE, 4 RODS TO 1 INCH.

V. Notes on Miscellaneous Field Work.

Although the entire farm land of the station has been placed under a careful supervision, as far as records of manuring, modes of cultivation and proper selection of crops for cultivation are concerned, a considerable part of it is not yet engaged in a strictly experimental work. The course adopted in the management of some fields aims at a timely preparation for some definite experiment contemplated in the near future; in others, to fit them for an economical production of fodder crops for the support of farm live stock. The fields designed for the cultivation of fruit-bearing trees and shrubs, to study the causes and the character of the diseases they are frequently heir to, are subdivided, and each plat subjected to a systematic treatment with different kinds and forms of manurial substances. The outlines of the area selected for permanent meadows are better defined, and the condition of the lands improved, by underdraining and ditching; different portions of the meadows are stocked with different varieties of grasses, to test their adaptation and their economical value. The ploughed lands are subjected periodically, whenever practicable, to drill cultivation, in the interest of a clean culture.

As the work accomplished in this direction can be better appreciated when stated later on in connection with the different results secured, a mere enumeration of the principal field crops raised during the past season may suffice here.

Hay,	37 tons.
Rowen,	15 tons.
Corn for ensilage,	19 tons.
Carrots,	5½ tons.
Sugar-beets,	4 tons.
Barley, grain and straw,	5,750 pounds.
Oats, grain and straw,	5,350 pounds.
Corn on the cob,	5,250 pounds.
Fodder corn,	7,000 pounds.
Corn stover,	7,000 pounds.
Sorghum fodder,	2,000 pounds.
Vetch and oats (green),	5,450 pounds.
Cow-pease (green),	6,600 pounds.
Serradella (green),	8,350 pounds.

VI. Department of Vegetable Physiology.

1. — Report by Prof. James Ellis Humphrey.

The first year of my work in this department has been largely one of organization and equipment. Beginning without equipment and in limited quarters, no elaborate work has been possible. The liberality of the last Legislature has removed this difficulty, however, and the new building and green-house provided for the department are just completed and occupied. Views of the new accommodations are given with this report.

Our equipment for certain lines of work, especially for the study of fungous diseases of plants, is now fairly good, and reference collections are well begun.

My report for 1889 comprises the following divisions: —

1. A general account of the *Fungi*, with special reference to those which cause diseases of cultivated plants.
2. A report on studies of the potato scab, carried on during the year.
3. Notes on various diseases of plants, which have been more or less prevalent on the station farm the past season.
4. Notes on specimens from other sources, referred to the department for examination and report.

1. General Account of the Fungi.

The past few years have been marked, in the United States, by a rapidly increasing interest in the relations of the *fungi* to the plants which they attack, and by a growing appreciation of the dreaded *rusts*, *smuts*, *mildews*, *blights* and other fungous diseases, and of their economic importance. These troubles, once regarded as mysterious, unavoidable, "Providential" visitations, are coming to be generally understood to be simple, direct effects of natural causes, and, as such, open to study and amenable to treatment. With this understanding comes, naturally, a comprehension of the value and practical utility of the scientific investigation of fungous diseases in all their phases.

The writer on *fungi* for popular information, meets at the outset a difficulty not experienced by all scientific writers, in the very nature of the *fungi* themselves. It is not easy to comprehend that organisms so small and so inconspicuous can possess such power for harm ; and it is not easy for the layman to understand that, in spite of their minuteness, they pass through life-cycles as constant and as definite as those of the plants on which they grow. It seems, therefore, worth while to attempt a general sketch of the growth and classification of those organisms of a vegetable nature, which attack and cause diseases of plants cultivated for useful products or for ornament. This account may serve as an introduction to the present as well as to future publications of this station on the subject of plant diseases, and to familiarize the reader, once for all, with the use of certain technical terms which are essential to exactness of statement. For the use of such terms no apology is needed. Their seeming difficulty lies simply in their unfamiliarity, which, as with all new words, soon wears away through use ; while their advantage over words already familiar is that they convey precise ideas, unmodified by preconceptions, and so greatly aid in clearness and definiteness of thought. The words printed in SMALL CAPITALS on the following pages may serve, also, as a general reference-list of technical or semi-technical terms, whose use is essential in treating of plant diseases, and whose meaning, here explained, will be assumed for the future to be understood by the readers of the publications of this station.

Any plant consists of one or more of the elementary plant-units, known as CELLS. A cell consists essentially of a mass of the semi-fluid living substance which is the basis of all life, usually surrounded by a firm membrane, known as the CELL-WALL. The simplest plants consist of a single cell each ; but the higher plants, on the other hand, are made up of immense numbers of cells, intimately united. Every living plant requires, for the renewal of worn-out parts and the growth of new parts, a supply of the materials necessary to such renewal and growth. Since both the living matter and the wall of the cell consist of compounds of a highly complex chemical constitution, the plant must be furnished with substances which contain the necessary chemical elements, in such form as to be readily convertible by it into vegetable tissue. Such substances constitute the real *food* of plants, in the same sense that what an animal eats constitutes its food; and both plants and animals find available food-supply only in *organic* substances. Inorganic materials can no more serve plants than they can serve animals as food; and just here a distinction must be made between the true food of plants and "plant food," so called in the discussion of fertilizers. We shall see later what is the relation to the plant of the latter, which consists essentially of inorganic substances.

Now, we know that an animal must obtain its food materials ready formed; that is, it cannot prepare the organic nutriment it requires from inorganic substances, but must obtain it from plants or from other animals. Here lies the important distinction between animals and *green* plants; for, in spite of the fact that, to most persons, the word *plant* carries with it the idea of greenness, it is by no means true that all plants are green. Green plants owe their color to the presence in their leaves and other green parts of a special pigment, known as leaf-green or CHLOROPHYLL. It may be added that some plants which are not green to the eye, yet contain chlorophyll, whose presence is hidden by some other masking pigment. The term "green plants" is here used, then, to designate all *chlorophyll-containing* plants, whatever their external appearance.

In chlorophyll we have the remarkable substance which bridges the gap between the inorganic and the organic. It is the one substance in nature on whose activity the continuance of all life depends. It alone has the power of forming organized food materials out of the elements of inorganic substances, but only under certain definite conditions. The green tissues of land plants receive water from the soil by way of their roots and stems, and absorb from the atmosphere the carbonic acid gas, or *carbon-dioxide*, which it contains in small proportion. These two simple inorganic compounds, water and carbon-dioxide, furnish the elements, *carbon*, *hydrogen* and *oxygen*, for the formation of certain organic compounds; and it is the peculiar property of chlorophyll, that, in its presence, and in its presence *only*, these elements are freed from their original combinations, and recombined into such organic compounds; though these changes can take place only when the chlorophyll is exposed to light of sufficient intensity, and when the water supplied to it holds in solution suitable inorganic compounds containing *nitrogen*, *potassium*, *phosphorus*, *calcium*, *magnesium*, *iron* and *sulphur*. Under natural conditions, waters from any soil in which plants will grow will be found to contain all these substances; but, in consequence of repeated cultivation and removal of the crops, the supply of these materials in a soil becomes greatly reduced, or, as we say, the soil becomes "exhausted." It then becomes necessary to supply the lacking constituents to the soil in the form of manures or fertilizers; and it is these necessary elements which are commonly spoken of as "plant food." Being inorganic, they cannot serve as food to the plant; but, as we have seen, their presence is indispensable to the elaboration of the true food of the plant from the materials furnished by water and carbon-dioxide. The precise relation of most of these elements to the life of the plant is hardly at all understood; but it is easy to show that, in the absence of either of them, there can be no permanently healthy activity. Their relation to the elaboration of organic food material from inorganic compounds has been compared, perhaps aptly, to that of oil to the smooth running of a steam-engine.

The necessary conditions being fulfilled, then, there occurs a recombination of the constitutents of water and carbon-dioxide into organic substance, excepting a part of the *oxygen*, which is set free into the atmosphere. Whatever temporary combinations they may pass through, the first visible and stable form in which these recombined elements appear is usually that of *starch*, which is the commonest form of organic food material that occurs in plants. After it is thus provided, by the activity of its chlorophyll, with an organized food supply, the plant utilizes it, as it needs, for the formation of tissue, either in repairing waste or in new growth.

But not all plants contain chlorophyll. Very many resemble animals in being entirely unable to provide their own nourishment, and in being, therefore, wholly dependent on external sources of food supply. Since their food supply consists of organic substances, it is evident that it must come from one of two sources; either from living organisms, animal or vegetable, or from dead organisms in a more or less advanced state of decomposition. Among flowering plants there are a few which are thus dependent, the best known of which are the white "Indian pipe" *(Monotropa)* of our woods, and the "Dodder," which twines its yellow or orange-colored leafless stems about our golden-rods and similar plants. But nearly all of the chlorophyll-less plants are of much simpler structure. They are mostly very small, and show no distinction of separate organs, like the stem and leaf of higher plants.

These simple plants may best be grouped under three heads, the true *Fungi*, the *Bacteria*, and the *Slime Moulds*. Many of them live on decaying organic matter, the remains of dead organisms of various sorts, and are known as SAPROPHYTES, or corpse-plants. Others, on the contrary, resemble the dodder in drawing their nourishment directly from living plants or animals, on which they are said to be PARASITES. The plant or animal at whose expense the parasite lives is called its HOST. It is this latter class of plants which has special interest to all who cultivate the higher plants, since its members cause the numerous and frequent plant diseases ordinarily known as *fungous* diseases. As we have seen, they attack their host plants for the purpose of obtaining the organic food supply necessary to their growth, which they are unable, from lack of chlorophyll, to provide for themselves.

The effects of different parasites on their host plants vary greatly. It is evident that the host plant must always be weakened by being robbed of a part of its food; but the amount taken seems, in some cases, to be insignificant, so that no serious damage results. On the other hand, the destruction of the host is sometimes so rapid and so complete that there can be no doubt that the parasite exercises a more positively fatal influence than merely that of turning the food supply of the plant from its proper channels. Between these extremes one may observe all degrees of harmfulness on the part of the various parasites; and the harm done by any particular one may vary widely in different cases, being largely controlled by varying conditions.

The great majority of parasitic fungi develop and vegetate within the tissues of their hosts; but some forms live and grow superficially, merely sending small branches into the cells of their hosts, for the purpose of absorbing nourishment. These *external* parasites are, as a rule, much less injurious to the plants they attack than are *internal* parasites.

A striking influence is often exerted on the habit of growth of a plant by the attacks of a parasite. Thus, it is often possible to tell which among a number of plants are infected, by their appearing taller or shorter, or slenderer or stouter, than the healthy plants; or they may appear of a lighter or darker shade of color; or, as frequently happens, the development of a fungus in the tissues of a plant may cause the affected parts to become abnormally developed and distorted to such an extent as to attract the attention of even the casual observer.

Just here should be noted an important fact for the student of parasitic fungi. As a rule, a given parasite is able to live on only a single host species, or on a few closely related species, seeming to require for its development the special chemical and other conditions afforded by some particular plant or particular group of similar plants. But, on the other hand, closely related parasites may attack widely different plants. For example, there is a very common "rust" which attacks the Canada thistle, and another which is equally common on grasses and grains. The two rusts are very closely related, while the relationship between the thistles and the grasses is very remote. Neither of these rusts can live on the host plant of the other.

The distinction between parasites and saprophytes, while very useful, must not be made too strict; for there are numerous fungi which, while naturally saprophytes, can assume the role of parasites under certain conditions, and others which may live as saprophytes, for a time at least, though ordinarily obtaining their nourishment parasitically. Many fungi, also, are probably parasites in some and saprophytes in other parts of the life-cycle.

We may pass now to a more particular account of the groups of chlorophyll-less plants already mentioned.

The SLIME MOULDS comprise a comparatively small number of plants, most of which are strictly saprophytic in their mode of life. A few of the simpler ones, however, are parasites, and their life history may be briefly sketched. They pass the winter or other unfavorable period in a so-called resting state, in which condition they appear as tiny globular bodies, each consisting of a mass of living matter, surrounded by a tough, firm coat. When warmth and moisture return, these outer coats crack open, and the living masses escape and begin to actively creep about, seeking for the plants on which they are able to live. Failing in this search, one of these tiny creeping masses soon dies; but, if successful, it penetrates the cells of the host plant, and proceeds to grow and mature at its expense. Toward the end of the growing season, the masses of living substance, which have greatly increased in size and now occupy the interiors of cells of the host whose contents they have absorbed, break up into many very small portions, each of which enters the resting state by becoming surrounded with a tough coat, and so awaits the next season. These organisms are clearly of the simplest nature, and it would perhaps be better to call them simply *organisms*, than to try to assign them a place on either side of the shadowy and indefinite line which separates the lowest plants and animals. By nearly universal consent, however, their study is assigned to the botanists. The most important member of this group, economically, is perhaps the parasite which causes the "club-foot" of cabbages and turnips, incidentally described in the article on "Potato Scab," in the report of this station for 1888.

The BACTERIA, or "germs," include the smallest known organisms, with both saprophytic and parasitic forms, and perhaps many which can live in either way. They consist of minute spheres, rods and threads, whose vital activity is the cause of many most remarkable phenomena. Among those which live saprophytically, one form produces the putrefaction of dead organic matter; another causes the souring of milk; another, the change of alcohol into acetic acid, which occurs when cider is converted into vinegar; another produces the rancidity of butter; and so on, through a long list. Many of the parasitic bacteria live in the bodies of men or other animals, and produce the most dreaded and dreadful contagious or *zymotic* diseases, like small-pox, anthrax or splenic fever, diphtheria, Asiatic cholera, hog cholera, Southern cattle fever, chicken cholera, pleuro-pneumonia, and many others. A few, also, produce diseases of plants, especially the rotting of bulbs and tubers. It is also claimed by careful investigators that the "fire blight" of pear and apple trees is due to the attacks of one of the bacteria.

These plants reproduce themselves chiefly by *fission*, a process which consists in the elongation of the organism up to a certain point, and the formation of a cross-wall dividing it into halves, which then separate and become independent. In its essentials the process is evidently a simple cutting in two.

The bacteria are universally disseminated, since their extreme smallness and consequent lightness render them easily transportable by the lightest breezes. When it is remembered that all putrefactive changes are due to their activity, their omnipresence begins to be realized.

The true FUNGI show greater complexity of structure than either of the groups just described. With a very few exceptions, they have a distinct *plant body* or vegetative portion, on which are developed the reproductive organs, or fruiting portion. The plant body consists of fine colorless threads, often branched, which spread over or through the substance from which the fungus draws its nourishment. These active, absorbing, vegetative threads of the plant body constitute the MYCELIUM of the fungus. From these are ultimately produced others, which are the fruiting or reproductive threads of the plant, and bear the reproductive bodies whose function is similar to that of the seeds of the higher plants, namely, the perpetuation of the species. Though produced in widely different ways, and varying among themselves far more than do the seeds of flowering plants, they may be, for convenience, all included under the general name SPORES. They are much simpler in structure than true *seeds*, and are usually microscopic in size.

In the simplest cases, the spores of a fungus are produced directly on the ends of separate and independent fruiting threads; in other cases they are the products of sexual processes, involving the union of distinct male and female threads; and, in the more complicated forms, numerous reproductive threads become intimately interlaced and compacted into a fruiting structure, often of considerable size, which bears spores in an interior cavity or cavities, or on some part of its surface. These spore-bearing structures reach their greatest development and conspicuousness in the "toadstools" and related fungi. In the modes in which spores are developed from the fruiting threads, we may distinguish two chief types. In one case, the end of a thread is simply cut off to form a spore; while, in the other, the end of the thread swells, and spores are formed free in the swollen portion. Those of the former type may be called *naked*, those of the latter, *enclosed*, spores. There is another classification of the spores of fungi, which is of special importance in the study of plant diseases. The majority of fungus spores can germinate at once and produce new fungi, under favorable conditions for vegetation. Of these there are some which live but a short time, and, unless they very soon find such conditions, fail to develop. They are produced in great numbers, however, may develop rapidly, and serve especially to spread the fungus by the infection of new hosts during the growing season. They may therefore be designated SUMMER SPORES. A familiar example is offered by the spores developed in red-brown streaks on the leaves and stalks of grain, in midsummer, and known as the "red rust." Other spores can live for a long time, awaiting suitable conditions, and ready to improve the first opportunity for germination. Still others, on the contrary, require a greater or less period of rest or quiescence before germination can take place. Such spores are usually able to withstand great extremes of temperature and dryness, and serve to perpetuate the plant through the winter or other unfavorable period; in contrast to the summer spores, which spread it rapidly at favorable seasons. They may be distinguished as RESTING

SPORES, and well illustrated by the spores which compose the black streaks which follow the red rust on the stalks of grain, and are known as "black rust."

A few fungi form peculiar bodies, which serve the purpose of resting spores, although they are of a very different nature. These are dark-colored masses of closely compacted mycelium, which can retain their vitality for a long time under circumstances unfavorable to growth, and finally, when favorable conditions recur, produce spore-bearing structures and spores. These special resting mycelia are known as SCLEROTIA, and are well illustrated by the *ergot* of grain, often known as "spurred rye."

A given species of fungus may produce, not merely one but two or several forms of spores and spore-bearing structures. These various forms may be produced at the same time or at nearly the same time, on the same mycelium; and, when this is the case, their connection and relations to each other are comparatively easy to make out. For instance, the streaks of rust on the culms of grain may often be found, at the proper season, with both red and black spores arising from the same mycelium, showing that the red and black rusts are only different spore-forms of the same fungus. But so simple a condition as this is the exceptional rather than the usual one. In very many fungi, the spores produced on one mycelium develop other mycelia essentially indistinguishable from the first, on which spores very unlike the first are formed; and these may, in their turn, give rise to a mycelium bearing spores like the first. For example, the mycelium developed next spring from the spores of many black rusts of the present season will produce, not new rust spores, but chains of wholly different spores, arranged in the form of tiny circular masses, each surrounded by a fringed or ragged border. From this characteristic structure, and the fact that they usually grow in close groups, these peculiar forms of fructification have received their name of *cluster cups*. On the mycelium arising from their spores are developed again rust spores like those which gave rise to the cluster-cup mycelium. Or again, the same mycelium may produce two or more forms of spores at quite different times, so that their connection is not directly traceable except by keeping the mycelium under long-continued observation. The spores and spore-bearing organs in the different stages of the same fungus may represent wholly different types of structure; so that the different forms have been, and, in the great majority of cases, still are, described and known under different names, as distinct fungi. This diversity of form, characteristic of the life-cycle of so many fungi, is known as PLEOMORPHISM. The subject is but just beginning to be understood, and its study is only begun. Consequently our knowledge of the whole matter is extremely fragmentary and unsatisfactory.

The fungi, like other plants, exhibit among themselves widely different types of structure, and may be separated into very distinct groups; while, within the limits of these groups, they show in greater or less degrees that similarity of organization and development which indicates descent from common ancestors, and consequent near relationship. These likenesses and differences enable us to arrange the fungi for convenience of study and discussion in a more or less natural order, though our knowledge is still very far from being sufficiently complete to afford us an arrangement which at all fully represents their relationships. It will be a great convenience, in future discussions, to have a general outline of the classification of the fungi and related groups; and the following is presented with a view to meeting this need. It is hoped that it may prove useful for reference, and sufficiently full, taken in connection with the preceding general account, to facilitate an intelligent understanding of discussions of particular fungous diseases. If any reader should feel, after reading this necessarily very brief and imperfect sketch, a desire for more detailed information concerning any fungi, the writer will be glad to render all possible assistance. In the following brief accounts of the various groups, attention has been given especially to those which include parasites on cultivated plants. The best available English name has been given to each group, and after the English name will be found, in each case, the name, in parentheses, by which the group is known to botanists.

I. Slime Moulds (*Myxomycetes*). — See above, p. 201.

II. Bacteria (*Schizomycetes*). — See above, p. 201.

III. Fungi. — These may be conveniently divided, for our purpose, into about seventeen groups, all but the last composed of quite closely related plants, as follows : —

1. *Downy mildews* and *white rusts* (*Peronosporeæ*) are internal parasites in the herbaceous parts of plants. Most of them produce summer spores, on threads which break through the surface of the plant into the air ; and resting spores, in the interior of the host. The latter are set free by the decay, during the winter, of the tissues in which they are imbedded, and then germinate in spring. The former are scattered by the currents of air, and rapidly infect new hosts.

Among diseases caused by attacks of members of this group of fungi are the potato rot, downy mildews of the grape, lettuce, onion, etc., and "damping off" of seedlings.

2. *Water moulds* (*Saprolegniaceæ*) are chiefly saprophytes on animal substances (dead insects, etc.) in water ; but one of them can attack living fish, notably the salmon, destroying the skin, commonly of the head region, by its gradual spread, and finally killing its victim.

3. *Leaf-gall fungi* (*Chytridiaceæ*) are very small and simple parasites, some of which form pustule-like swellings of herbaceous parts of flowering plants, and so merit the name here given. A majority of the members of the group, however, are parasites on the lower water plants, and of no present interest.

4. *True moulds* (*Mucorini*) comprise fungi which are saprophytes on common vegetable substances, and others which are parasites on the mycelia of the former. They are of no special interest in the present connection.

5. *Insect fungi* (*Entomophthoreæ*) are nearly all parasites of insects, and cause the death of their hosts. Their only economic interest is in the possibility which has been suggested that they may be artificially propagated for use in destroying insect pests. The cheme however is one of very doubtful practicability.

6. *Smuts* (*Ustilagineæ*) are internal parasites of flowering plants, and develop both mycelium and spores in the

tissues of their hosts. The mycelium is largely used up in the formation of spores, so that, at maturity, little is to be found but a dark-brown or black powdery mass of spores. In most cases these latter can germinate at once under certain conditions; but they may live for a very long time ready to germinate when favorable conditions occur. The spores of some smuts seem to be true resting spores; and those of many other species approach that condition, in that they germinate much more readily after a period of rest than when just mature. The smuts of corn, of wheat and other grains, and of the onion, are only too well known.

7. *Rusts* (*Uredineæ*) are especially interesting for their striking and remarkable pleomorphism, already referred to. They are very common parasites of flowering plants, and the typical species produce three chief spore forms. Individual variations within the group make it difficult to give a general account, but the following will apply to most of the rusts. Early in the season the fungus appears in its first or *cluster-cup* stage, described above, and shown in the yellow patches so common on barberry leaves in June. The spores of this form produce fresh mycelia, which give rise to the second, and later to the third, spore form. These second and third forms, are, as has been already stated, the *red* and *black* rusts, respectively. This is the typically complete condition, but in very many cases one or even two of the forms are unknown. The spores of the *cluster-cup* and *red-rust* forms are summer spores, while those of the *black-rust* are usually resting spores, though not always so.

Frequently the various forms of a rust fungus follow each other on the same host plant; but the difficulty of a complete knowledge of many of them is further complicated by the fact that the *cluster-cup* form occurs on one host, and the other two on a widely different one. For example, the cluster-cup of the barberry is the first stage of the fungus whose second and third stages are the red and black rusts of wheat and various other grains and grasses, as has been shown by careful and repeated cultures. This form of pleomorphism, in which the different spore forms of a parasitic fungus occur on different hosts, is known as HETERŒCISM.

A few closely related plants belonging to the group of rusts constitute important exceptions to the typical life history, outlined above. These are *heterœcismal* fungi, whose second form is unknown, and probably does not exist. Their cluster-cup forms cause the familiar "rusting" of the leaves, and sometimes of the fruits, of apple trees, hawthorns and related woody plants, in summer; and their third forms are the "cedar apples," whose gelatinous fruiting masses are equally common on our red cedars or "savins" and junipers, in spring. It will be seen from the above that the "cedar apples," which correspond to the *black-rust* stage of other rusts, appear *earlier* in the season than the *cluster-cup* stage; naturally, then, their spores are not resting spores, the fungi being carried through the winter by their mycelia, which live in the branches of the hosts.

Among important isolated forms, whose other stages are unknown, may be named the orange-colored rust which covers the lower surfaces of the leaves of blackberries and raspberries in spring and summer.

8. *Jelly fungi* (*Tremellini*) are very interesting botanically, since they show distinct relationships with both the rusts and the toadstools; but they are saprophytes, and require no further notice here, beyond the statement that they form gelatinous masses of various colors, from white to black, on dead wood, and are most abundant in late fall and early spring.

9. *Toadstools* (*Hymenomycetes*) are perhaps the most abundant of fungi, besides comprising more species than any other group. They are nearly all saprophytes, and many grow in places where the presence of organized food material would hardly be suspected. Their spores are borne free at the ends of spore-producing threads, which are usually packed closely together, and form a fruiting surface. In the simplest members of the group this surface is the only one exposed to the air; but in the more elaborate forms, popularly known as toadstools, there are upper and under surfaces distinguishable on the fruiting structure, and of these the latter is the spore-producing surface.

A few forms are of present interest. One of the simplest members of this group causes the leaves and fruits of the blueberry, cranberry, and related plants, to become swollen and covered by a white "bloom," composed of the spores of the fungus, and often does considerable damage. The mycelia of several toadstools grow in the wood or between the wood and bark of trees, and may do much harm to timber. In the case of some species, the mycelia may form long, brown, branching *sclerotia*, somewhat resembling roots, which are not uncommon beneath the bark of decaying logs. This group includes the mushrooms, the chantarelle, and many other valuable food fungi.

10. *Puff-balls* (*Gasteromycetes*) are nearly related to the last group, and, like most of its members, are saprophytes. A few of the species are edible, but otherwise the group has no economic importance, although including many familiarly known forms.

11. *Yeasts* (*Saccharomycetes*) are very simple fungi, in which the plant is reduced to a single elliptical cell, and reproduces itself chiefly by a process of budding. A slight projection grows out from the cell, and gradually increases in size until it reaches dimensions not much less than those of its parent cell, from which it then becomes detached, and begins to lead an independent life, budding in its turn. Although saprophytes, these fungi are of great interest economically, from their producing the alcoholic fermentation, and their consequent practical application in baking and brewing. The change known as alcoholic fermentation consists in the separation of the chemical elements composing *sugar*, and their recombination into other compounds, chiefly alcohol and carbon-dioxide; and the power to produce this change is possessed in a remarkable degree by some of the yeasts.

12. *Leaf-curls* (*Exoasceæ*) are parasitic fungi of very simple structure. They cause a swelling and curling of the parts attacked, which are commonly the leaves, though sometimes the fruits. The distortions are covered by a "bloom" composed of tiny club-shaped sacs, projecting from between the surface cells of the host, and containing minute spores. The "curl" of peach leaves and the swelling of unripe plums into "plum pockets" are caused by these fungi.

13. *Powdery mildews* (*Perisporiaceæ*) are external parasites of herbaceous parts of plants. The white threads of the mycelium spread over the surface, sending absorbing organs into the tissues, and bear abundantly the fruiting structures, which are recognizable by the naked eye as tiny black bodies, when ripe. Each of these bodies consists of a hard shell, surrounding from one to several somewhat egg-shaped sacs, in which the spores are contained. The best-known of these fungi are the powdery mildews of the grape and the gooseberry.

14. *Black fungi* (*Pyrenomycetes*) may be so called from the fact that a large majority of them produce a blackened, carbonized appearance of the leaves or branches which they attack, making them look as though burned. Sometimes, however, they are of a light or bright color, so that the name is not entirely appropriate. In cavities in these black or colored fruiting structures are contained the spores, enclosed in oblong or club-shaped sacs, which escape into the air through tiny pores connecting with the exterior. Many of these fungi also produce summer spores, on threads which cover the outer surface with a "bloom," or line cavities similar to those which contain the spores in sacs. Most of these plants are saprophytes, but a few attack hosts still living. Of them there are a few which are too well known, notably those which cause the "black-knot" of plum and cherry trees, and the "black-rot" of the grape.

15. *Saucer fungi* (*Discomycetes*) are so called from the form of the fruiting portion of many members of the group, though, on account of their wide variations, no single descriptive term is applicable to all. They are chiefly saprophytes, and the larger forms sometimes strikingly recall the toadstools in habit and place of growth. The spores are contained, as in the last two groups, in closed sacs, which, in the saucer fungi, stand erect and closely packed together on the upper or inner face of the saucer, which they cover with a distinct spore-bearing layer. A few of these fungi live, at least under certain conditions, as parasites, and develop small *sclerotia* in the tissues of their hosts, thus producing the so-called "sclerotia diseases" of clover, onions, hemp, etc.

16. *Truffles* (*Tuberaceæ*) are a small group of subterranean saprophytes, some of which are highly prized as articles of food.

17. *Imperfect fungi* is a general term to include an immense number of forms supposed to be mostly early stages in the development of members of some of the groups already described, especially various summer-spore forms of fungi belonging to groups 13, 14 and 15. Here are comprised the very different forms known under the names *Sphæropsideæ*, *Melanconieæ*, *Hyphomycetes*, etc. The spores are usually borne naked on the ends or sides of spore-producing threads, and germinate at once, as a rule. These fungi are, in large proportion, parasites, and produce diseases of widely differing external appearance, known variously by the names "anthracnose," "blight," "spot," "scab," "rot," etc.

A fuller account of these fungi is impossible, except by subdividing them into several groups, because of the very heterogeneous character of the contents of this general *catch-all* for forms not placed elsewhere. The fact that such a miscellaneous and enormous collection of "imperfect" form-species must form a part of any enumeration of fungi, is the best evidence of the incompleteness of our knowledge. In proportion as that knowledge increases, the extent of this collection must diminish.

The above outline covers the principal fungi, and will, it is hoped, to some extent subserve the purposes for which it has been prepared. Being now in possession of some general facts concerning fungi, we may attempt to deduce from them some of those principles which must guide us in attempts to lessen or prevent the ravages of diseases caused by these plants.

Since parasitic fungi develop, for the most part, within the tissues of their hosts, it is evident that there is little possibility of saving a plant once fairly infected; for what would kill the parasite would ordinarily be fatal to the host. The powdery mildews, being external parasites, may perhaps be killed after they are well developed. Our chief aim, however, must be to protect the plant by the thorough application to its exposed surfaces of some preparation which shall, without injuring the plant, kill or at least prevent the germination of fungus spores which may alight upon it, and which would, under natural conditions, germinate there and infect the plant. Many such preparations have been proposed and tested, a few with encouraging results. While this whole subject is but little developed as yet, two formulæ may be given which promise to be quite generally useful: —

Copper Mixture of Gironde or Bordeaux Mixture.

A. Dissolve six pounds sulphate of copper (blue stone) in sixteen gallons water.

B. Slake four pounds quicklime with six gallons water.

C. When cool, mix *A* and *B*, stirring thoroughly.

Blue Water or Eau Celeste.

Dissolve one pound sulphate of copper in four gallons warm water; when cool, add one pint commercial ammonia and eighteen gallons water.

The latter of these may be applied by means of any apparatus which thoroughly distributes it; but the former requires the use of a spraying pump, with a special agitating nozzle to keep it evenly and thoroughly mixed, since the lime is simply held in suspension, without being dissolved.

It seems hardly necessary to point out that a vigorously healthy plant will be far less subject to the attacks of fungi, and will suffer far less from such attacks, than a poorly nourished one. Both theory and experience point to this obvious conclusion.

After a plant is too far gone to be saved, measures should be taken to prevent the infection of neighboring plants, still intact, and of plants of the same kind, in the following season. With the latter object in view, one should destroy the affected parts, and especially any dead or fallen parts or refuse, which may harbor the spores of the fungus during the winter. In dealing with fungi which produce resting spores, these precautions should be taken with especial thoroughness. The destruction of infectious material should be as complete as *burning* can make it, for nothing less than this will assure the death of all the spores contained in it. In dealing with any fungous disease, one of the secrets of success may be summed up in the word, *thoroughness*.

Numerous cases can be cited of common weeds or wild plants, each of which is so closely related to some species of cultivated plants that it is liable to attack by the same fungi that infest its cultivated relative. Where this is true, the wild plant may serve equally with the cultivated one to perpetuate the fungus, and may keep it alive during a time when the latter is not grown, or may become a source of infection for a cultivated field, previously free. For example, the "black-knot" fungus grows on our wild cherries, as well as on cultivated cherries and plums; the lettuce mildew occurs on several species of "wild lettuce;" and the grapevine mildew, besides occurring on wild grape vines, has been found on the Virginia creeper. The bearing of these facts on questions of preventing and checking the various diseases is obvious.

Finally, it is clear that epidemic diseases cannot be successfully combated without general co-operation throughout an infected region. The attempts of half a dozen intelligent men to protect their crops may be almost of no avail, if one lazy or "conservative" neighbor refuses to join in the attempt, and allows his adjacent field to afford a breeding-place for the very fungus our progressive friends are fighting.

Successful dealing with diseases caused by parasitic fungi may be said, then, to be based on the following essentials: *promptness, thoroughness, cleanliness, intelligent treatment, co-operation.*

The writer wishes to come into much more general communication with the farmers, market gardeners, horticulturists, florists, and all who cultivate plants, in the State. He especially and urgently requests that specimens be sent him of plants affected by any disease, not caused by insects, which may come to the attention of any reader of this report.

Very much aid to a fuller knowledge of many diseases can be afforded if those who are the losers by them will co-operate to render all possible assistance, even to the extent of going to some trouble, to those engaged in their study. Without such co-operation and assistance, our work must necessarily be far less effective and our studies far less complete in their results.

2. *The Potato Scab.*

In the report of this station for 1888, pages 131 to 138, was given an account of the disease of potatoes known as "scab," with a summary of the views held up to that time as to its nature and cause. It was shown that, while the characters of the disease are sufficiently marked and far too familiar, its cause is still to be explained. On this point three principal theories are held, which may be stated briefly as follows: (1) the theory of W. G. Smith and others, that the trouble is caused by the irritating action of foreign substances in the soil; (2) the view that it is due to peculiar soil conditions; and (3) Brunchorst's claim that it is caused by the attacks of a parasite belonging to the slime moulds. Various American experiments were quoted, bearing on the effects of the presence or absence of manure, excess or deficiency of water, use of smooth or scabby "seed," use of fungicides, and cultivation of light or dark skinned potatoes.

In the spring of 1889, arrangements were made for experiments on the same plot on which the scab had appeared for several years, — Field E, containing about three-tenths of an acre. This plot, which had been ploughed the previous fall, was ploughed again in the spring, and divided into twenty-eight sections of three rows each, the section being regarded as the unit, and each section being treated, as nearly as possible, in a uniform manner.

The whole plot, excepting section 1, at the south end, was dressed with an application of ground bone and potash-magnesia sulphate, at the rate of 600 pounds of the former and 290 pounds of the latter per acre. In addition to suggestions for the details of experiments drawn from current theories and previous experiments, two were adopted from other sources; namely, to test the effect of tobacco applied in the drill in the form of ground tobacco refuse, and to observe the results, as to the development of scab, of deep planting. Arrangements were made to facilitate the irrigation of a part of the sections; but, owing to the extreme rainfall of the season, no use was made of the means provided, and no comparison of the effects of excess and deficiency of moisture on the development of the scab can be instituted, as the whole field received the same liberal natural watering.

The first five columns of the following table show the details of the planting of each section. It will be seen that the plan affords material for the following comparisons of results, as to the development of scab: 1. Deep *vs.* shallow planting; 2. Susceptibility to attack of light and dark skinned varieties; 3. Barn-yard manure *vs.* commercial fertilizers; 4. Effect of tobacco dust in drill; 5. Scabby *vs.* smooth "seed."

Number of Sect.	Quality of Seed.	Variety of Seed.	How Fertilized.	How Planted.	Scabbiness of Crop.
1	Smooth,	Beauty of Hebron,	Barn-yard manure,	In hills,	Very badly scabbed.
2	“	“ “	Bone and potash,	In drill,	Considerably scabbed.
3	“	“ “	“ “	“	Considerably scabbed.
4	“	“ “	“ “	“	Badly scabbed.
5	“	“ “	Bone, potash and tobacco,	“	Badly scabbed.
6	Scabby, except bl'k,	1st and 2d rows, Beauty of Hebron; 3d row, ½ white, ½ black,	Bone and potash,	“	Badly scabbed, except bl'k.
7	Scabby,	1st row, Beauty of Hebron; 2d and 3d rows, white,	“ “	In trench (deep),	Considerably scabbed.
8	Smooth,	Beauty of Hebron,	“ “	In trench,	Somewhat scabbed.
9	“	“ “	“ “	In drill,	Badly scabbed.
10	“	“ “	“ “	“	Considerably scabbed.
11	“	“ “	“ “	“	Considerably scabbed.
12	“	“ “	“ “	In trench,	Considerably scabbed.
13	Scabby,	1st row, Beauty of Hebron; 2d and 3d rows, white,	“ “	In drill,	Considerably scabbed.

14	Smooth,	Beauty of Hebron,	Bone, potash and barn-yard manure,	In hills,	Very badly scabbed.
15	"	" "	Bone and potash,	In drill,	Badly scabbed.
16	"	" "	" "	"	Badly scabbed.
17	"	" "	Bone, potash and tobacco,	"	Badly scabbed.
18	"	" "	Bone and potash,	"	Considerably scabbed.
19	"	Polaris,	" "	"	Considerably scabbed.
20	"	"	" "	"	Badly scabbed.
21	"	Beauty of Hebron,	" "	"	Considerably scabbed.
22	"	" "	" "	"	Considerably scabbed.
23	"	Polaris,	" "	"	Considerably scabbed.
24	"	"	" "	"	Considerably scabbed.
25	"	"	" "	In trench,	Somewhat scabbed.
26	"	"	" "	In drill,	Somewhat scabbed.
27	"	"	" "	"	Considerably scabbed.
28	"	Beauty of Hebron,	" "	"	Considerably scabbed.

The scabby "white" potatoes planted on sections 6, 7 and 13 were of a very light-skinned sort, much resembling the Gregory, though not certainly of that variety. Those called "black," planted on section 6, were a very few small, elongated, dark-purple tubers, found in the station barn; the "tops" showed the same dark color which marked the tubers, and produced the only entirely smooth potatoes on the field. The plot was planted May 4, and the first shoots broke through the soil on the 17th. A week later they were well up, and a marked backwardness of sections 1 and 14 was observed, as compared with the rest. The retarding effect of planting directly on manure continued to be distinctly noticeable for three weeks longer. Various explanations may be offered, however, for this fact, which, by itself, has no special significance. The field was cultivated and hoed at sufficiently frequent intervals, and the plants grew well, being kept fairly free from the potato beetle by two light applications of Paris green, combined with hand-picking.

On the 4th of June young tubers were found, of the size of a pea, and from this time their size and number rapidly increased. On July 22 the first indications of the *rot* made their appearance on the leaves of some plants near the south end of the plot, and had soon spread over almost the entire field. As soon as possible, namely, on the 29th of July, the potatoes were dug, in order to avoid the loss of results from the scab experiments to which the rotting of the tubers would lead. The potatoes from each section were kept distinct, and carefully examined with reference to their relative scabbiness. The result in each case is briefly stated in terms of a scale of five grades, running from "generally smooth" to "very badly scabbed," in the last column of the foregoing table. A compilation of the results there given, with regard to their bearing on the points before indicated, shows that: 1. Deep planting appears to tend to diminish the development of scab, though further experiments in this direction are very desirable. 2. While the very dark potatoes were wholly free from scab, little or no difference was to be noticed in the susceptibility of the three light varieties planted; it is to be regretted that none of the best red varieties were available for the comparison. 3. The potatoes raised on barn-yard manure were markedly more scabby and more deeply scabbed than the rest. 4. Tobacco dust in the drill had no appreciable effect in increasing or diminishing the scab. 5. Scabby "seed" produces a crop neither better nor worse than that grown from smooth potatoes. None of these results are new, but they may serve as further material on which to base general conclusions, and as confirmatory of the results of most previous similar experiments. But all such results are comparatively without significance, so long as the *cause* of the trouble remains unknown, and we are as much as ever in the dark, so far as any basis of rational experimentation or treatment is concerned; therefore the most attention has been given to the study of the development of the scab.

From the time when tubers began to be formed till the crop was dug, plants were taken up at intervals, and carefully examined. The first suspicious spots were found on some small tubers June 20, and the first unmistakable scab was noticed on the 28th. After this time abundant specimens were obtainable. It is worthy of note that the first examples of affected tubers were obtained from sections 1 and 14, on which barn-yard manure was used, and that they always furnished the most and scabbiest material.

The scab always begins in very small spots, and spreads from these. When quite small, the spots usually show dark-brown centres from which the lighter marginal portions seem to have spread. These dark central spots mark the position of the *lenticels* of the tuber, in which the disease originates. The microscopic structure of the diseased spots is the same at all stages of their development. The first suspicious spots, detected June 20, on very young tubers, proved, on microscopic examination, to be young scab-spots, and could not be distinguished in minute structure from the large patches on a full-grown tuber. The characteristic change which produces the appearance and condition known as *scab* consists in the browning, drying and shrivelling of the walls of a few layers of the surface cells of the tuber, which produces a hard and rough crust. The difference between a very small spot and a large patch of scabby surface is wholly one of kind, the latter developing from the former by the simple extension of the pathological condition described, over a greater surface. In this way is produced what may be described as the *superficial* form of the disease, illustrated by the lower specimen in Fig. 1, opposite page 136 of our report for 1888, and by Fig. 1, accompanying the present paper. The drying and browning sometimes penetrates to a considerable depth, and causes the death of masses of tissue of some volume, which finally become destroyed by decay, frequently with the assistance of worms and other animals. Their presence in this form of the disease has apparently led to the belief, held by many persons, that such animals are the cause of the trouble. This may be called the *deep* form of the scab, and shows, in its completest development, extensive cavities in the tubers, where tissue has died and decayed. It is illustrated by the upper specimen in Fig. 1 of last year's report, and by the accompanying Fig. 2. Both forms of the disease coexist under various conditions to such a degree that the causes determining the development of the deep form are wholly indefinable.

Very careful examinations were made, to determine whether the present disease is caused by any plant or animal, either as a true parasite or otherwise; but no organism of any sort was found constantly or even frequently present at any stage of its progress, and there can be no doubt that it is *not* the result of the activity or development of any living thing other than the potato plant. Various experiments, referred to in the paper in last year's report, above mentioned, have pointed to this conclusion, and their results would be very puzzling had the present investigations resulted otherwise. The search for some organism standing in causal relation to the trouble, has, however, been conducted with much care, in deference to the claims and theory of Brunchorst, quoted above, and to be discussed later.

Since the scientific name of an organism indicates always a definite and determinable thing, one can always be sure, in the study of a disease plainly caused by a plant or animal, as to the validity of his comparisons of his results with those of others who have studied the same disease. But the words "scab," "Schorf" and "Skurv" are not terms which mean only definite things, but are of popular and general application; and the assumption that they are used in different countries to designate the same disease, remains merely an assumption until it is proved by direct comparison to be correct. Indeed, the assumption that the word "scab" is used, throughout our own country, for the same affection, is, perhaps, hardly justified; but, as it is borne out by specimens from various parts of New England, its correctness for the whole country is taken for granted. In order, however, to settle the uncertainty whether the three words above quoted are synonymous, two leading writers on the subject were requested to furnish material for comparison with American *scabby* potatoes. Dr. Sorauer, director of the experiment station at Proskau, Germany, was asked to send potatoes affected with the disease known in Germany as "Schorf" or "Grind," and Dr. Brunchorst of Bergen, Norway, to send potatoes attacked by the disease known in that country as "Skurv," and said by him to be caused by a species of slime mould. Both very kindly responded, and the writer wishes here to extend to both botanists his very sincere thanks for their interest and assistance.

Dr. Sorauer sent several tubers affected with what, to the naked eye, resembles in all respects our *superficial* form of scab; and microscopic examination fully establishes its identity with our disease. The accompanying Fig. 3 is made from a photograph of one of the potatoes sent by Dr. Sorauer. The German "Schorf" and the English "scab" are, then, synonyms, as applied to diseases of the potato.

From Dr. Brunchorst, a photograph of tubers attacked by "Skurv" has been received; but, unfortunately, the specimens of such tubers, promised by him, have failed to arrive, and it is impossible to accurately compare the disease with our own. Such comparisons as are rendered possible by Dr. Brunchorst's descriptions and figures and by the photograph he has had the goodness to send, point, however, to the conclusion that he is dealing with a disease very distinct from the *scab*, and that his assumption that the American and German diseases are identical with the Norwegian, is incorrect.

Fig. 4 is a reproduction of Brunchorst's photograph. Until more positive evidence can be obtained from the study of specimens, it seems safest to assume that the "Skurv" studied by him is quite different from the other diseases, and of different origin. This view removes difficulties not readily explained otherwise.

Bulletin No. 34 of this station, published last June, contained a series of questions concerning potato scab, addressed to farmers, especially those of this State, which they were requested to answer from their experience, for the assistance of this department in the study of the disease. Some ten thousand copies of this bulletin were sent out, and some agricultural journals showed their interest by printing and calling attention to them. The replies to this widely circulated request were *six* in number, and, of these, *four* came from neighboring States. It is fair to ask the farmers of Massachusetts to imagine how great is the encouragement derived from such a result by those who are working in their interest, and wish their co-operation and assistance. The facts stated require no comment.

In conclusion, it may be remarked that the results of the year are more negative than positive. It is certain that our disease is the same as that discussed by German writers, and that it is not caused by any parasitic organism.

Several years' observations at this station point, also, to the correctness of the view that the cause of our trouble is to be sought in peculiar physical or chemical conditions of the soil, though the opinion that excessive moisture is a sufficient controlling cause seems hardly tenable.

It seems to be generally conceded that potatoes become most scabby in heavy, close soil, and least so in light, loose soil; that worse crops in this respect are raised on land which has been cultivated for some time than on freshly broken ground. Indeed, the belief is quite general that new soil will give a smooth crop. This was not the case, however, at this station, the past season, when land broken for the first time in years gave a badly scabby crop. It should be added that this was on a stiff, heavy, poorly drained soil.

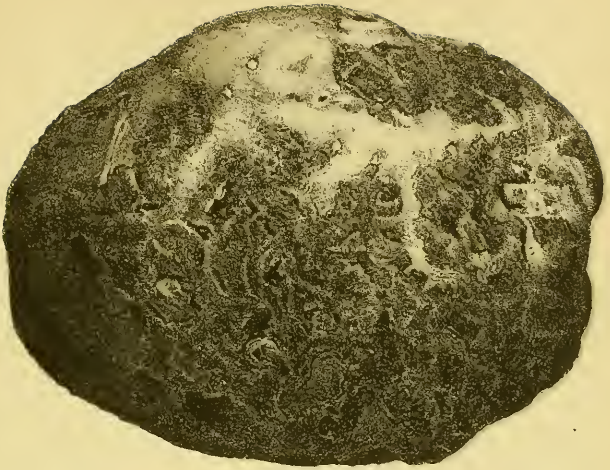


Fig. 1.

"Surface" Scab, from Station Plots.

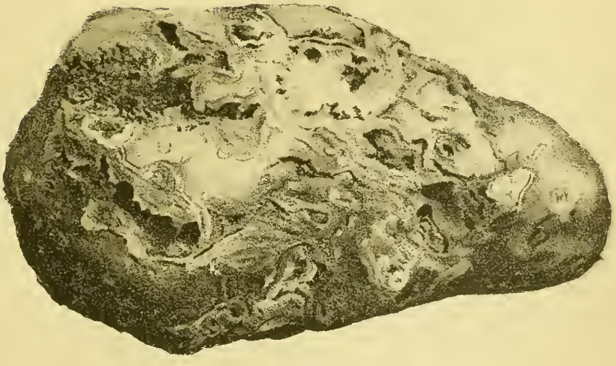


Fig. 2.

"Deep" Scab, from Station Plots.

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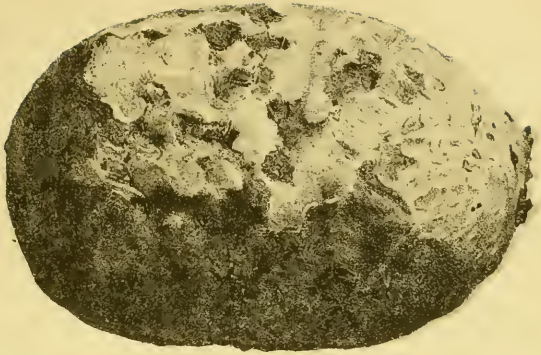

FIG. 3.

German *Schorf* (="Surface" Scab.)

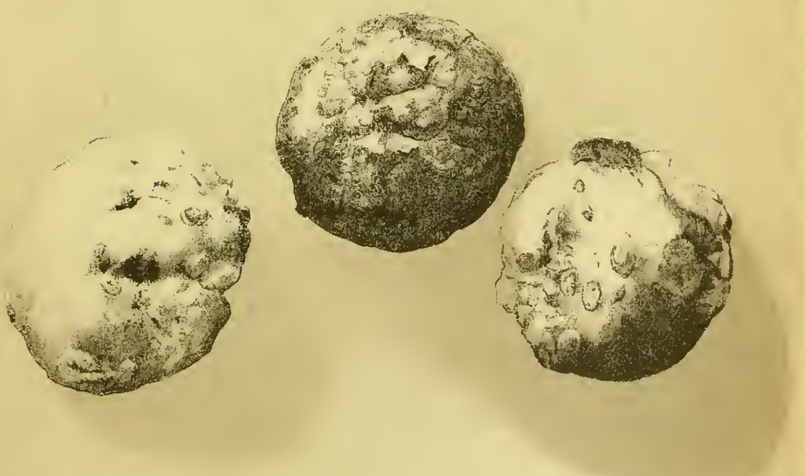

FIG. 4.

Norwegian *Skurv.*

WRIGHT & POTTER PRINTING CO. STATE PRINTERS

It seems at present probable that excess of moisture tends to produce the scab, rather through its influence in rendering the soil heavy and clinging, than in any more direct way; and it is recommended that, to secure a smooth crop, potatoes be planted in light, porous soil, kept well stirred. Observations will be continued next season, in the light of past experience.

3. *Fungous Diseases on Station Farm.*

The following notes include only such diseases as attacked crops grown on the station farm during the past season with sufficient violence to produce results of economic importance. Many fungi, of course, were found, whose presence was of no practical importance to the various plants on which they occurred; but a few produced striking results by their abundance and vigor. The meteorological conditions of the season were peculiarly favorable to the development of fungi.

1. The *smut* of barley and oats (*Ustilago segetum* Pers.*) attacked both of those grains on the east fields and on the experimental plats to such an extent that the "smutted" heads formed a very appreciable portion of the whole. Even were the affected heads but a small fraction of one per cent. of the whole, the loss on a large field would be sufficient to justify attempts to save it, as a little calculation will show. The parasite under consideration appears on the fruiting heads of the small grains, and, when ripe, presents only the mass of black spores characteristic of the *smuts*, which completely replaces the substance of the seed. The enclosing seed coats burst open, and the spores are carried in all directions by the wind, finding lodgement on the surrounding plants and soil. Although the smut spores ripen considerably earlier than does the grain in the sound heads, grain from a smutted field is sure to have them adhering to its surface and entangled in the tuft of hairs at its end, especially if smutted heads have been mixed with the sound ones in threshing. Unless they are present in very large numbers,

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* It may be explained that the scientific name of a plant consists of three parts, the name of the *genus* or group of closely related plants to which it belongs, the name of its particular kind or *species*, and the name (in full or abbreviated) of the person or persons to whom it owes the name.

they cannot be detected by the unaided eye. These spores remain unchanged during the winter, and are ready for germination with the seed, when it is planted in the spring. Experiments have shown that the germinating tubes of the smut fungus can penetrate and infect the plants of grain only when they are very young seedlings, with very tender and easily penetrable tissues. Having once gained entrance to the interior of such a plant, however, the fungus grows with the plant, invading the new tissues as they are formed, and finally reaching its complete development by producing its reproductive bodies in the place of the destroyed reproductive bodies of its host. If the grain, with adhering smut spores, be fed to horses or cattle, the spores pass through the body and are voided unharmed. And not merely unharmed; their passage through the animal body seems to cause them to germinate more readily than before, and they produce, in the manure heap, tiny bodies which increase rapidly by a process of budding similar to that of the yeast fungi. Thus a few spores may produce, in a short time, a multitude of these tiny buds, each of which can infect a grain seedling with the smut parasite.

Since the infection of neighboring plants cannot be caused by a "smutty" plant, the problem of dealing with the present trouble is much simpler than similar problems concerning the numerous fungi which spread rapidly by summer spores. It is evident that it is useless to attempt to save a plant once attacked by smut; but the facts just stated concerning the fungus under discussion point to three lines of defence against its attacks: (1) The conditions for the germination of the seed and the growth of the seedling should be as favorable as possible, in order that the period of susceptibility to infection may be made as short as possible. To this end, well-matured seed should be sown on well-prepared and well-drained soil, in favorable "growing" weather. (2) Suitable commercial fertilizers should replace animal manures, on fields to be sown to grain. This will eliminate from the problem an important complication. (3) The seed grain should be treated, before being sown, with a preparation which will kill the adhering spores, with the least damage to the seed. The best for this purpose seems to be a one-half per cent. solution of sulphate of copper, prepared by dissolving it in water in the proportion of one pound to twenty-five gallons. The grain should be thoroughly wet with this solution, and allowed to soak in it for from twelve to twenty-four hours. It may then be spread out for a few hours, till dry enough to be readily sown. This treatment is very efficacious and inexpensive.

2. The *spot disease* of sugar beets appeared on the leaves of that crop about the end of June, in the form of dead, dry, circular patches, from one-eighth to three-eighths of an inch in diameter. These patches are the result of the death of the leaf tissues, caused by their invasion by a fungus mycelium. While a few patches would do little harm on the large leaf of a beet, they often become so abundant, as in the present case, as to destroy a large part of the tissue of the leaves. Since, as we have seen, the leaves, being the chlorophyll-containing organs, are those on which the plant depends for its supply of organic food material, it is evident how serious for the plant must be the loss, during its time of active growth, of a large fraction of its working leaf surface. In the case under notice, the spots gradually extended and increased, until, in August, the leaves died completely from the violence of the attack. By this time, however, the roots were so well grown that they were able to put out promptly a fresh growth of leaves, which continued through the rest of the season, though themselves affected somewhat by the *spot*. Clearly, the production of new leaves must have involved the conversion, for that purpose, of a considerable amount of stored material from the root, which ought to have remained there. This loss, with that due to the diminution of active surface on both sets of leaves, must very materially reduce the amount of solid matter in the roots, and lessen their feeding value in proportion.

Two fungus forms appeared on the spots on the station beets, both of them belonging to the *Imperfect Fungi*. Up to about the 10th of July, the most abundant form was that known to botanists as *Septoria Betæ* West., while after that time the chief form, and, late in the season, apparently the only form, was that known as *Cercospora beticola* Sacc. In view of their appearance on the same spots, and in the relations described, it is pertinent to inquire if they may not be forms of the same pleomorphic fungus. Direct proof, either for or against this hypothesis, is, however, still wanting.

No very definite directions for combating this trouble can be given, in the absence of more complete knowledge of the accompanying fungus forms than we yet have. As both *Septoria* and *Cercospora* spores quickly germinate and infect new hosts, that is, are summer spores, it is probable that spraying the crop as soon as the spots begin to appear may check its spread. It is probable that the "Eau Celeste" would give good results. Leaves badly attacked should be burned; all refuse should be cleared from the field at the end of the season, and burned; and the same crop should not be planted on the same ground or in its immediate neighborhood, the following year.

3. The *rot* of potatoes has been unusually serious on the station plots, as throughout the State, during the season just past. This disease, known as *blight* when it attacks the tops, and as *rot* when the tubers are affected, is due to a fungus of the downy mildew group, *Phytophthora infestans* deBary. Its abundance and destructiveness in 1889 have called out so many descriptions and recommendations concerning the fungus and means for checking it, that an extended account is superfluous here. The fungus spreads very rapidly by means of summer spores, but, so far as is known, does not, like most of the downy mildews, produce resting spores. Its only known mode of passing the winter is by the hibernation of its mycelium in the host tubers. Special care should be taken, then, to avoid planting "seed" potatoes which contain this hibernating mycelium, whose presence is commonly indicated by dark-brown sunken spots on the surface of the tuber, beneath which the tissues are more or less "rotted." A fuller account of this very fatal disease, by the present writer, may be found in Bulletin No. 6 of the Hatch Experiment Station of the Massachusetts Agricultural College.

The blight which appeared on the leaves of potatoes on the plot devoted to *scab* experiments, as previously mentioned, spread rapidly, but not with perfect regularity. When the leaves and stems were mostly killed by the fungus, the fourth day after its appearance, those on sections 1 and 14, the third row of section 6, and the second and third rows of both 7 and 13, were still fresh and comparatively unharmed. Comparison with the table given above shows that the sections which suffered least were those in which the potatoes were planted directly on manure, and the rows which were planted with the varieties designated as *white* and *black*. That some varieties are less susceptible than others to attacks of the rot, has been repeatedly shown; but why planting on manure should give protection against it, as seems here to have been the case, is not easy to see; yet there was no other difference in conditions between plots 1 and 14, on one hand, and 2–4, 9–11, and 15–16, on the other hand. Yet all the latter suffered equally and very severely. The attack was not of the most violent sort, and, even on the worst-affected plants, there was not the complete collapse into a slimy, putrescent mass, which is the result of the extreme form of the disease. Nothing now remained to be done but to harvest the potatoes as quickly as possible. Press of other farm work prevented immediate attention, but they were all harvested before the end of the month, in very good condition, so far as the *rot* was concerned. Later potatoes, on other fields, which received less prompt attention, were an almost total loss.

Notes on other fungous diseases are reserved until more complete data can be accumulated concerning them.

4. Notes on Material referred to the Department.

Some of the examinations which have been made by the department, of specimens referred to it, may be of sufficient general interest to warrant a brief discussion here.

1. *Fungus in Cellar.* — In December, 1888, a quantity of a white, flocculent substance, mixed with gravel from the cellar bottom on which it had grown, was sent in for examination. The house from whose cellar the material was taken was a tenement-house, and the white growth in question was a source of alarm to the tenants, who threatened to

leave, fearing that its appearance was an indication of the unhealthfulness of the premises.

It was evident to the unaided eye, and microscopic examination confirmed the opinion, that the white material was the sterile mycelium of some fungus. As there was no trace of spore formation, it was impossible to say to what fungus the mycelium belonged, though more probably to some member of the toadstool group.

The only conditions necessary to the development of such mycelia are the presence of spores, and of certain degrees of temperature and moisture. The latter conditions are afforded by even the best of cellars, which receive no artificial heat, and fungus spores penetrate every crevice with the air in which they float. Not only are such growths perfectly harmless in themselves, but their occasional appearance is no indication of unhealthful conditions; although their very constant or luxuriant appearance is often an accompaniment of extreme dampness. For the sake of neatness, it is best to remove them with rake or broom, and prevent their reappearance on the same surface by the free application of lime, either dry or in the form of whitewash.

A report to this effect was made in the present case, but it was afterwards learned that the tenants had already left, victims to their superstitious fears and dread of the "mysterious."

It should be remarked here that the appearance of white fungus mycelia, followed by the development, on the surface of the mass, of a rusty-brown spore layer, with the exudation of watery drops at its margin, should receive prompt attention. The fungus which answers to this description belongs to the toadstool group, and appears on woodwork or even on cellar bottoms. It produces a very rapid and destructive "dry rot" of timber, and is known in Germany as the "house fungus." It should be thoroughly destroyed, and all woodwork in its vicinity painted or well whitewashed.

2. *Black Spot of Rose Leaves.* — A disease affecting the leaves of roses growing in the Durfee plant-house of the Massachusetts Agricultural College was referred by Prof. S. T. Maynard to this department for examination and

report, in December, 1888. The leaves showed the dark, cloudy and dendritic patches, and the small, slightly raised pustules characteristic of the "black spot" of the rose; and the microscope showed the presence of an abundant mycelium in the spots, producing at certain points masses of the spores of the "black-spot" fungus, *Actinonema rosæ* Fr. The spore-bearing spots are indicated by the pustules, which are formed by the elevation of the surface layer or *epidermis* of the leaf by the developing spore masses. As the internal tissue of the leaf is invaded by the mycelium, it is gradually killed, and loses its green color; so arise the discolored spots, which give the disease its name, and which, at first small, spread radially in all directions from the point of infection. The fungus which causes this trouble is one of the imperfect fungi, and its relation to other forms remains still undetermined.

The same disease appeared abundantly on leaves of roses cultivated out of doors in the garden of a very successful amateur in Amherst, last summer.

Infected leaves should be carefully collected and destroyed, to prevent the dissemination of spores; and it is probable that spraying with some fungicide will prove efficacious in checking the disease, if done early and frequently enough. For fuller details and recommendations, reference may be had to the report of the mycologist of the United States Department of Agriculture, for 1887, p. 366, and to Bulletin No. 6 of the Hatch Experiment Station, before referred to.

3. *Nematode Disease of Cucumbers.* — A disease seriously affecting cucumbers raised under glass came to my attention in July last, through Mr. H. T. Fernald of Amherst. It manifests itself first in the yellowing of the foliage, which is followed by the death of the plant. But the real seat of trouble is in the roots, on which are formed rough, tubercle-like swellings or *galls*, in which the tissues are loose and spongy, and easily crumble. Examination showed the presence in these galls of very numerous microscopic worms and their eggs. The worms measure perhaps one-fiftieth of an inch in length, and belong to the group known as thread-worms or *nematodes*, which attack the roots of many plants with fatal results.

This nematode disease of cucumbers is known in England, and is said to have been successfully treated by watering the soil in which the diseased plants were growing, with a weak solution of permanganate of potash, which appears to be fatal to the worms, without injuring the plants. It is suggested that the sulphate of manganese would probably be as efficient as the permanganate of potash, while it is much cheaper. The writer will be glad to communicate with anyone who is troubled by this disease, and wishes to experiment in combating it.

2. — Communication by C. A. Goessmann.

The investigations concerning the effect of various modes of cultivation and of manuring on the general character and composition of fruits and garden crops will be resumed, as far as practicable, during the coming year. The circumstances which some years ago obliged me to discontinue that work as outlined in our first and second annual reports, under the heading "Chemistry in Fruit Culture," are not existing now. The late permanent assignment of suitable fields, as well as the recent erection of buildings designed with a view to offer to growing plants the necessary protection against objectionable features of climate and weather, promise to favor our plans of operation. The co-operation of our experiments in the field and in the vegetation house cannot fail to assist materially in drawing correct conclusions from our results.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

- I. Communication on commercial fertilizers: —
    - 1. General introduction.
    - 2. Laws for the regulation of the trade in commercial fertilizers.
    - 3. List of licensed manufacturers for May 1, 1889, to May 1, 1890.
    - 4. Analyses of licensed fertilizers.
    - 5. Analyses of commercial fertilizers and manurial substances sent on for examination.
    - 6. Miscellaneous analyses.
- II. Water analyses.
- III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.
- IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

I. COMMUNICATION ON COMMERCIAL FERTILIZERS.

1. General introduction.
2. Laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers for May 1, 1889, to May 1, 1890.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

1. *General Introduction.*

The new duties assigned to the director of the station render it necessary to discriminate, in the future, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general, between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers, and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition, and to such additional information as relates to the latter. The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents, has, therefore, to be discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a consideration of the particular composition of the different brands of fertilizers offered for their patronage, — a circumstance not unfrequently overlooked.

The approximate market value of the different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance. To select judiciously from among the various brands of fertilizers offered for patronage, requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and in such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food — *i.e*, phosphoric acid, nitrogen and potash — which they contain. To ascertain, by this mode of valuation, the approximate market value of a fertilizer (*i.e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid, and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse, and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility and the more or less rapid diffusion of the different articles of plant food throughout the soil. The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration, at the same time, their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals. (1889.)

	Cents per Pound.
Nitrogen in ammoniates,	19
Nitrogen in nitrates,	17
Organic nitrogen in dry and fine-ground fish, meat and blood,	19
Organic nitrogen in cotton-seed meal and castor pomace,	15
Organic nitrogen in fine-ground bone and tankage,	16½
Organic nitrogen in fine-ground medium bone and tankage,	13
Organic nitrogen in medium bone and tankage,	10½
Organic nitrogen in coarser bone and tankage,	8½
Organic nitrogen in hair, horn shavings and coarse fish scraps,	8
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,	7½

Trade Values of Fertilizing Ingredients — Concluded.

	Cents per Pound.
Phosphoric acid in dry ground bone, fish bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarse bone and tankage,	4
Phosphoric acid in fine-ground rock phosphate,	2
Potash as high-grade sulphate, and in form free from muriates or chlorides; ashes, etc.,	6
Potash as kainite,	4½
Potash as muriate,	4½

The organic nitrogen in superphosphates, special manures and mixed fertilizers of a high grade, is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, nineteen cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. For similar reasons, the insoluble phosphoric acid is valued in this connection at three cents; it being assumed, unless found otherwise, that it is from bone or similar source, and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but two cents per pound.

The above trade values are the figures at which, in the six months preceding March, 1889, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials, which are the regular source of supply. They also correspond to the average wholesale prices for the six months ending March 1, plus twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as —

Sulphate of ammonia,
Nitrate of soda,
Muriate of potash,
Sulphate of potash,
Dried blood,
Dried ground meat,
Dry ground fish,
Azotin,
Ammonite,
Castor pomace,
Bone and tankage,
Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect, at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary character of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guaranty of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale in our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing circumstances. Requests for analyses of substances, as fodder articles, fertilizers, etc., coming through officers of agricultural societies and farmers' clubs within the State, will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without charge for the services rendered. Applications of private parties for analyses of substances, free of charge, will receive a careful consideration, whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent on to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

2. *Laws for the Regulation of the Trade in Commercial Fertilizers.*

[Chap. 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, *etc.*, *as follows:*

Section 1. Every lot or parcel of commercial fertilizers or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*

Instructions issued at the Beginning of the Season, to Dealers in Commercial Fertilizers.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide, guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers, but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the 1st of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers, are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the director of the Massachusetts State Agricultural Experiment Station.

3. List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in This State during the Past Year, and the Brands Licensed by Each.

Forest City Wood Ash Company, London, Ontario, Canada: —
    Canada Unleached Wood Ashes.

Bowker Fertilizer Company, Boston, Mass: —
    Stockbridge Manures.
    Bowker's Hill and Drill Phosphate
    Bowker's Ammoniated Bone Fertilizer.
    Bowker's Lawn and Garden Fertilizer.
    Bowker's Fish and Potash.
    Bowker's Dry Ground Fish.
    Gloucester Fish and Potash.
    Fine-ground Bone.
    Plain Superphosphate.
    Kainite.
    Nitrate of Soda.
    Dried Blood.
    Dissolved Bone-black.
    Muriate of Potash.
    Sulphate of Potash.

National Fertilizer Company, Bridgeport, Conn.: —
    Chittenden's Complete Fertilizer
    Chittenden's Fish and Potash.
    Chittenden's Phosphate.

Hargrave Manufacturing Company, Fall River, Mass.: —
    Hargrave's Bone.

William E. Fyfe & Co., Clinton, Mass.: —
    Canada Unleached Wood Ashes.

Edmund Hersey, Hingham, Mass.: —
    Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Read Fertilizer Company, Syracuse, N. Y.: —
- Farmer's Brand.
- Lion Brand.
- High-grade Farmer's Friend Special.
- Sampson or Lion Special.

E. Frank Coe, New York, N. Y.: —
- E. Frank Coe's Gold Brand Excelsior Guano.
- Fish and Potash.
- Potato Fertilizer.
- Alkaline Bone.
- E. Frank Coe's High-grade Ammoniated Bone Superphosphate.

Cumberland Bone Company, Portland, Me.: —
- Seeding-down Fertilizer.
- Cumberland Superphosphate.

Williams & Clark Company, New York, N. Y.: —
- Americus Ammoniated Bone Superphosphate.
- Potato Phosphate.

Great Eastern Fertilizer Company, Rutland, Vt.: —
- Great Eastern General for Grain and Grass.
- Great Eastern Vegetable, Vine and Tobacco Fertilizer.
- Great Eastern General Oats, Buckwheat and Seeding-down Phosphate.

Joseph Church & Co, Tiverton, R. I.: —
- Fish and Potash.
- Church's Special.
- Church's Standard.
- Dried and Ground Fish.

Thompson & Edwards Fertilizer Company, Chicago, Ill.: —
- World of Good Tobacco Guano.

J. A. Tucker & Co., Boston, Mass.: —
- Original Bay State Bone Superphosphate.
- Imperial Bone Superphosphate.

Edw. F. Jennison, Lancaster, Mass.: —
- Jennison's Complete Animal Fertilizer.

Orient Guano Manufacturing Company, New York, N. Y.: —
- Suffolk County.
- Orient Complete Manures.
- Fish and Potash.

Davidge Fertilizer Company, New York, N. Y.: —
- Davidge's Potato Manure.
- Davidge's Vegetator.
- Davidge's Special Favorite.

Lister's Agricultural Chemical Works, Newark, N. J.: —
- Lister's Standard Superphosphate of Lime.
- Lister's Ammoniated Dissolved Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

J. M. Butman, Lowell, Mass.: —
  Lowell Bone Fertilizer.

Adams & Thomas, Springfield, Mass.: —
  Adams Market Bone Fertilizer.

Whittemore Brothers, Wayland, Mass.: —
  Whittemore's Complete Manure.

Mayo & Hix, Boston, Mass.: —
  Mayo Superphosphate.

John C. Dow & Co., Boston, Mass : —
  Dow's Ground Bone Fertilizer.

J. E. Soper & Co , Boston, Mass.: —
  Cotton-seed Hull Ashes.

F. C. Sturtevant, Hartford, Conn : —
  Tobacco Stems.

E. H. Smith, Northborough, Mass.: —
  Smith's Steamed Bone.

A. L. Ames, Peabody, Mass.: —
  Ames' Bone Fertilizer.

The Mapes Formula and Peruvian Guano Company, New York, N. Y.: —
  The Mapes Bone Manures.
  Peruvian Guanos.
  The Mapes Superphosphate.
  The Mapes Special Corn Manures.

C. A. Bartlett, Worcester, Mass : —
  C. A. Bartlett's Pure Ground Bone.
  Animal Fertilizer.

Bradley Fertilizer Company, Boston, Mass.: —
  Bradley's XL Phosphate.
  B. D. Sea-fowl Guano.
  Coe's Superphosphate.
  Fish and Potash.
  Pure Fine-ground Bone.
  Bradley s Complete Manures: —
    For Potatoes and Vegetables.
    For Corn and Grain.
    For Top-dressing Grass and Grain.
  Bradley's Grass Manure for Top-dressing.
  Bradley's Potato Manure.
  Nitrate of Soda.
  Sulphate of Ammonia.
  Muriate of Potash.
  Dissolved Bone-black.

Cleveland Dryer Company, Cleveland, Ohio: —
  Cleveland Potato Phosphate.
  Cleveland Superphosphate.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

American Manufacturing Company, Boston, Mass.: —
The Allen Fertilizer.

G. E. Holmes, New Worcester, Mass.: —
Fine-ground Bone.

Wm. J. Brightman & Co., Tiverton, R. I.: —
Fish and Potash.
Superphosphate.
Dry Ground Fish.

S. Winter, Brockton, Mass.: —
S. Winter's Pure Ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y.: —
New Rival Ammoniated Superphosphate.
Buffalo Superphosphate, No. 2.
Special Potato Manure.
Pure Ground Bone.
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Queen City Phosphate.
Vegetable Bone Superphosphate.
Ammoniated Wheat and Corn Phosphate.

Standard Fertilizer Company, Boston, Mass.: —
Standard Superphosphate.
Breck's Lawn and Garden Dressing.

Munroe, Judson & Stroup, Oswego, N. Y.: —
Unleached Canada Wood Ashes.

Benj. Randall, Boston, Mass.: —
Randall's Market-garden Fertilizer.
Randall's Combined Bone.

The Le Page Company, Boston, Mass.: —
The Red Star Brand 203 Fertilizer.
The Red Star Brand Special Potato Fertilizer.

Pacific Guano Company, Boston, Mass.: —
Soluble Pacific Guano.
Fish and Potash.
Special Potato Manure.

The Quinnipiac Company, New London, Conn.: —
Quinnipiac Phosphate.
Quinnipiac Potato Manure.
Quinnipiac Dry Ground Fish.
Quinnipiac Fish and Potash.

A. Lee & Co., Boston, Mass.: —
Lawrence Fertilizer.
Ground Bone.

3. List of Dealers who have secured Certificates, etc. — Concluded.

H. J. Baker & Bros., New York, N. Y.: —
  A. A. Ammoniated Superphosphate.
  Pelican Bone Fertilizer.
  Potato Manure.

John G. Jefferds, Worcester, Mass.: —
  Jefferds' Animal Fertilizer.
  Jefferds' Fine-ground Bone.

N. Ward Company, Boston, Mass.: —
  N. Ward Company's High-grade Animal Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I.: —
  Darling's Animal Fertilizer.
  Extra Bone Phosphate.
  Darling's Potato and Root Crop Manure.
  Darling's Pure Bone.
  Muriate of Potash.
  Sulphate of Potash.

Butler, Breed & Co , Boston, Mass.: —
  Economic No. 1 Fertilizer for Grass.
  Economic No. 2 Fertilizer for Pasture.
  Economic No. 3 Fertilizer for Corn.
  Economic No. 4 Fertilizer for Potatoes.
  Economic No. 7 Fertilizer for Garden.

Stearns' Fertilizer Company, New York, N. Y.: —
  Stearns' Ammoniated Bone Superphosphate.
  Stearns' American Guano.

Thos. Hersom & Co., New Bedford, Mass.: —
  Pure Fine-ground Bone.

H. L. Phelps, Southampton, Mass.: —
  H. L. Phelps' Complete Manure.

Prentiss, Brooks & Co., Holyoke, Mass.: —
  Dry Fish.
  Dissolved Bone-black.
  Muriate of Potash.
  Nitrate of Soda.

4. Analyses of Commercial Fertilizers collected during the Past Season in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
7	High-grade Farmer's Friend Special,	Read Fertilizer Company, New York,	Pittsfield.
8	Farmer's Friend,	Read Fertilizer Company, New York,	Pittsfield.
9	Lion Brand,	Read Fertilizer Company, New York,	Pittsfield.
11	Quinnipiac Phosphate,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
12	Quinnipiac Fish and Potash,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
13	Quinnipiac Potato Manure,	The Quinnipiac Company, New London, Conn.,	No. Amherst.
17	Vegetator,	Davidge Fertilizer Company, New York,	Amherst.
18	Bowker's Potato Grower,	Bowker Fertilizer Company, Boston,	Sunderland.
23	Chittenden's Universal Phosphate,	National Fertilizer Company, Bridgeport, Conn.,	Sunderland.
24	Chittenden's Tobacco Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Sunderland.
33	Mapes' Potato Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
	Bones and Tankage.		
2	Hargrave's Bone,	Hargrave Manufacturing Company, Fall River, Mass.,	Fall River.
3	Steamed Bone,	Edmund Hersey, Hingham, Mass.,	Hingham.
4	Steamed Bone,	Edward H. Smith, Northborough, Mass.,	Amherst.
38	Holmes' Steamed Bone,	G. E. Holmes, Worcester, Mass.,	Worcester.
43	Bartlett's Steamed Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.		Mechanical Analyses.			
								Total.		Available.							
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Fine.	Fine Medium.	Medium.	Coarse Medium.
	Compound Fertilizers.																
7	High-grade Farmer's Friend Special,	14.20	4.24	3.3—4.5	3.38	2.02	2.38	7.78	6—7	5.40	5—6	9.84	10—12				
8	Farmer's Friend,	14.10	2.72	2.06—2.88	7.24	2.33	2.81	12.38	11—13	9.57	9—11	2.32	–*				
9	Lion Brand,	12.54	1.08	.82—1.65	6.40	2.43	2.07	10.90	10—12	8.83	8—10	3.66	–*				
11	Quinnipiac Phosphate,	18.49	2.70	2.5—3.25	3.74	6.75	2.46	12.95	10—16	10.49	9—13	2.05	2—3*				
12	Quinnipiac Fish and Potash,	18.28	4.28	3.25—4.25	0.48	5.82	4.03	10.33	5—7	6.30	3—5	4.48	3—5*				
13	Quinnipiac Potato Manure,	16.67	2.96	2.5—3.25	3.33	3.38	1.43	8.14	6—12	6.71	5—9	5.34	5—6*				
17	Vegetator,	6.75	3.20	3.3—4.12	4.91	0.51	1.51	6.93	–	5.42	5—7	4.08	–*				
18	Bowker's Tobacco Grower,	6.05	3.36	3.25—4.25	6.94	1.38	3.55	11.87	–	8.32	8—10	5.52	4—5				
23	Chittenden's Universal Phosphate,	13.12	2.86	2.—2.9	6.24	3.72	2.53	12.49	11—12	9.96	9—11	2.86	2—3				
24	Chittenden's Tobacco Fertilizer,	9.44	3.28	3.3—4.9	7.04	2.16	2.89	12.09	8—10	9.20	6—8	5.56	–*				
33	Mapes' Potato Manure,	6.45	3.72	3.71—4.12	6.27	4.13	2.24	12.64	8—10	10.40	6—8	6.56	6—8*				
	Bones and Tankage.																
2	Hargrave's Bone,	6.61	3.02	–	0.28	10.01	15.67	25.96	–	10.29	–			–	–	–	–
3	Steamed Bone,	2.65	3.18	–	0.31	8.39	10.87	19.57	–	8.70	–			34.41	21.03	21.96	22.60
4	Steamed Bone,	5.46	4.48	4.—4.5	0.38	8.72	12.78	21.98	21.5—22.5	9.10	6.6—9.1			39.45	36.35	22.95	1.25
38	Holmes' Steamed Bone,	10.87	3.27	2.5—3.5	0.32	11.37	10.56	22.25	22—24	11.69	–			25.79	47.72	26.49	–
43	Bartlett's Steamed Bone,	5.75	3.15	2.39	0.42	13.03	12.79	26.24	27.35	13.45	7.59			39.87	39.98	20.15	–

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
5	Lowell Bone Fertilizer,	J. M. Butman, Lowell, Mass.,	Lowell.
10	Sampson Brand or Lion Special,	Read Fertilizer Company, New York,	Pittsfield.
15	Special Favorite,	Davidge Fertilizer Company, New York,	Amherst.
19	Stockbridge's Tobacco Manure,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
25	Cumberland Bone Superphosphate,	Cumberland Bone Company, Portland, Me.,	Sunderland.
32	Mapes' Complete Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
39	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
42	Jefferds' Animal Fertilizer with Potash,	J. G. Jefferds, Worcester, Mass.,	Worcester.
44	Americus Brand Ammoniated Superphosphate,	Williams & Clark Company, New York,	Worcester.
54	Church's Fish and Potash,	Joseph Church & Co., Tiverton, R.I.,	Springfield.
55	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
57	Dry Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
58	Bradley's Fish and Potash, "A" Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
68	Original Bay State Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Chelsea.
69	Imperial Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Chelsea.
83	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Ipswich.
84	Dow's Nitrogenous Superphosphate,	J. C. Dow & Co., Boston, Mass.,	Ipswich.
88	Darling's Pure Dissolved Bone,	Darling Fertilizer Company, Pawtucket, R. I.,	Ipswich.
111	Extra Bone Phosphate,	Darling Fertilizer Company, Pawtucket, R. I.,	Taunton.
30	Cotton-hull Ashes,	Quinnipiac Company, New London, Conn.,	Northampton.
29	Muriate of Potash,	Quinnipiac Company, New London, Conn.,	Northampton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
								TOTAL.		AVAILABLE.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
5	Lowell Bone Fertilizer,	7.28	2.35	2.0—2.5	5.41	8.12	2.01	15.54	14.5—17.5	13.53	12.5—14.5	3.63	3—3.5
10	Sampson Brand or Lion Special,	14.04	2.76	2.47—3.30	6 14	2.58	2.51	11 23	10—12	8.72	8—10	3.96	–*
15	Special Favorite,	10.32	1.32	1.24—2.06	7.84	1.53	2.28	11 65	12—14	9.37	10—12	1.45	1.5—2.5
19	Stockbridge's Potato Manure,	4.87	5.62	5.75—6.75	3.40	1.84	2.78	8.02	5—7	5.24	4—5	10.26	10—12*
25	Cumberland Bone Superphosphate,	12.44	2.32	2—3	6.04	6.40	4.04	16.48	13—14	12.44	9—13	2.72	2—3
32	Mapes' Complete Manure,	10.72	3.12	3.30—4.12	3.89	3.24	3.97	11.10	10—12	7.13	–	4.17	4—5
39	Bradley's XL Superphosphate of Lime,	14.52	3.52	2.50—3.25	8.09	2.56	1.89	12.54	11—14	10.65	9—11	2.24	2—3
42	Jefferds' Animal Fertilizer with Potash,	3.88	3.12	4.12—5.77	0.28	9.63	11.33	21.24	14—16	9.91	–	4.83	5—7
44	Americus Brand Ammoniated Superphosphate,	16.59	2.37	2—3	8.92	1.73	0.28	10.93	11—16	10.65	10—12	1.82	2—3*
54	Church's Fish and Potash,	18.82	3.74	3.3—4.12	2.02	2.62	1.12	5.76	5—6	4.64	–	4.18	3—5
55	Adams' Market Bone Fertilizer,	11.66	3.08	2.5—3.5	1.92	5.57	3.10	10.59	8—10	7.49	6—8	5.60	3—5
57	Dry Fish Guano,	9.22	9.00	8.24—9.89	0.46	4.45	2.48	7.39	6—8	4.91	–	–	–
58	Bradley's Fish and Potash, "A" Brand,	16.46	3.25	2—3	2 57	1.98	1.45	6.00	–	4.55	4—6	4.99	4—6
68	Original Bay State Bone Superphosphate,	16.91	2.77	2.47—2.88	5.97	1.67	2.26	10.90	10—12	7.64	9—9.5	2.27	2—3
69	Imperial Bone Superphosphate,	20.10	2.38	2.06—2.47	5 53	2.50	2.75	10.78	9—10	8.03	8—9	1.85	2.5—3
83	Ames' Bone Fertilizer,	11.29	2.66	1.65—2.47	6.08	3.29	0.32	9.69	8—12	9.37	8—10	1.39	1—3
84	Dow's Nitrogenous Superphosphate,	11.16	2.65	2.06—2.88	3.34	7.11	2.37	12.82	–	10.45	8—10	3 78	3—4
88	Darling's Pure Dissolved Bone,	4.67	2.01	2.06—2.88	7.04	8.95	2.56	18.55	16—18	15.99	14—16	–	–
111	Extra Bone Phosphate,	10.81	2.60	2.47—3.30	5.76	2.91	2.33	11.00	10—12	8.67	7—9	3.28	3—5
30	Cotton-hull Ashes,	8.11	–	–	–	–	–	9.62	–	–	–	22.80	
29	Muriate of Potash,	2 05	–	–	–	–	–	–	–	–	–	49.67	–†

* Sulphate of potash the source of potash.

† Guaranteed eighty per cent. muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
16	Potato Fertilizer,	Davidge Fertilizer Company, New York,	Amherst.
20	Animal Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
49	Ammoniated Bone Superphosphate, Americus Brand,	Williams & Clark Co., New York,	Springfield.
52	A. A. Ammoniated Bone Superphosphate,	H. J. Baker & Bro., New York,	Springfield.
108	A. A. Ammoniated Bone Superphosphate,	H. J. Baker & Bro., New York,	New Bedford.
53	Potato Manure,	H. J. Baker & Bro., New York.	Springfield.
59	Chittenden's Complete Fertilizer for Grass,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
61	Mapes' Complete Manure for Light and Sandy Soils,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
65	Red Brand, Special Fertilizer for Potatoes, Cabbage and Pease,	Le Page Company, Boston, Mass.,	Boston.
76	Randall Market Garden Fertilizer,	Benj. Randall, Boston, Mass ,	Boston.
98	Crocker's New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
102	Lawrence Fertilizer,	Lee, Blackburn & Co., Lawrence, Mass.,	Lawrence.
110	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R I.,	Taunton.
124	Jennison's Animal Fertilizer,	Edward F. Jennison, Lancaster, Mass.,	South Lincoln.
129	Lister's Ammoniated Dissolved Bone,	Lister's Agricultural Chemical Works, Newark, N. J.,	Turner's Falls.
132	Sea-fowl Guano,	Bradley Fertilizer Company, Boston, Mass.,	Turner's Falls.
134	Orient Complete Manure,	Orient Guano Company, Orient, L. I.,	Sheffield.
135	Great Eastern Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
137	Potato Fertilizer,	E. Frank Coe, New York,	Westfield.
	Bones and Tankage.		
123	Hersom's Tankage,	Thomas Hersom & Co., New Bedford,	New Bedford.
95	Bowker's Fine-ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
118	Hargrave's Fine-ground Bone,	Hargrave Manufacturing Company, Fall River,	Fall River.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.		Mechanical Analyses.			
								Total.		Available.							
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaran-teed.	Found.	Guaran-teed.	Found.	Guaranteed.	Fine.	Fine Medium.	Medium.	Coarse Medium.
	Compound Fertilizers.																
16	Potato Fertilizer,	12.37	3.08	2.88—3.71	8.10	1.06	1.32	10.18	10—12	9.16	9.5—11	3.02	–*				
20	Animal Fertilizer,	9.93	2.97	–	6.14	1.96	6.40	14.50	10—12	8.10	6—8	3.34	–†				
49	Ammon. Bone Superphos., Americus Brand,	16.86	2.66	2—3	9.03	1.65	0.23	10.91	10—16	10.68	10—12	1.98	2—3				
52 108	A. A. Ammoniated Superphosphate,	13.32	3.42	2.47—3.3	10.09	1.36	1.13	12.58	–	11.45	10—12	2.58	2—3				
53	Potato Manure,	9.89	4.17	3.30	5.95	1.34	0.81	8.10	–	7.29	5.75	9.33	10.				
59	Chittenden's Complete Fertilizer for Grass,	12.86	3.62	4.12—4.94	5.88	3.43	2.91	12.22	6—8	9.31	4—6	5.56	5—7				
61	Mapes' Com. Manure for Light and Sandy Soil,	11.40	5.66	4.94—6.59	5.50	1.19	2.30	8.99	8—10	6.69	8.	6.46	6—8				
65	Red Star Brand, Spec. Fert. for Potatoes, etc,	15.37	3.01	3—4	4.16	2.35	3.26	9.77	8—10	6.51	6—8	3.34	–*				
76	Randall's Market Garden Fertilizer,	11.22	3.36	2.88—3.71	5.28	2.51	1.66	9.45	–	7.79	8.5—11	3.68	4—5				
98	Crocker's New Rival Ammo. Superphosphate,	15.57	1.43	1.23—2.06	7.94	1.72	1.33	11.05	–	9.66	10—12	2.08	–*				
102	Lawrence Fertilizer,	15.37	1.78	2.06—2.88	9.86	1.34	0.95	12.15	10—12	11.20	–	1.61	2—3				
110	Potato and Root Crop Manure,	12.57	3.12	2.88—4.12	4.81	1.91	3.81	10.53	10—12	6.72	–	8.96	7—9				
124	Jennison's Animal Fertilizer,	3.59	5.40	3—4	0.08	5.93	6.78	12.79	11—12.5	6.01	6—8	8.94	7—8				
129	Lister's Ammoniated Dissolved Bone,	14.84	2.09	1.65—2.06	7.14	2.07	3.39	12.60	10—13	9.21	8—10	1.67	1—2				
132	Sea-fowl Guano,	13.61	2.60	2.06—2.68	7.38	2.84	3.19	13.41	11—14	10.22	9—11	2.42	2—3				
134	Orient Complete Manure,	13.84	2.20	1.65—2.47	8.71	0.18	1.41	10.30	–	8.89	8—12	2.28	2—4				
135	Great Eastern Tobacco Fertilizer,	14.12	2.31	1.65—2.47	7.54	1.58	1.56	10.68	–	9.12	8—12	4.51	6—8				
137	Potato Fertilizer,	13.21	2.06	2—2.5	7.48	1.53	1.66	10.67	–	9.01	8—11	5.52	–*				
	Bones and Tankage.																
123	Hersom's Tankage,	3.42	4.24	2.08	–	6.73	12.79	19.52	29.42	6.73	13.62			–	–	–	–
95	Bowker's Fine-ground Bone,	9.15	3.48	2.5—3.25	1.66	7.27	14.66	23.59	18—22	8.93	–			50.80	28.77	11.18	9.25
118	Hargrave's Fine-ground Bone,	10.28	3.25	3.93	.37	12.01	13.19	25.57	18.80	12.38	4.12			43.43	23.01	14.20	19.36

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* Sulphate of potash the source of potash.

† Guaranteed as muriate of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
1	Ames' Bone Fertilizer,	A. L. Ames, Peabody, Mass.,	Peabody.
28	Stockbridge's Manure for Top Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
46	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Fitchburg.
71	Standard Superphosphate,	Standard Fertilizer Company, Duxbury, Mass ,	Boston.
78	Economic No. 1, for Grass,	Economic Fertilizer Company, Boston, Mass.,	Boston.
105	Church's Dry Ground Fish,	Joseph Church & Co., Tiverton, R. I.,	New Bedford.
127	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Worcester.
144	Cumberland Seeding-down Fertilizer,	Cumberland Bone Company, Portland, Me.,	Dighton.
145	The Allen Fertilizer,	The American Manufacturing Company, Boston, Mass.,	Woburn.
146	Mayo's Superphosphate,	Mayo & Hix, Boston, Mass.,	Waltham.
147	Davidge's Potato Manure,	Davidge Fertilizer Company, New York,	Belchertown.
148	Special Favorite,	Davidge Fertilizer Company, New York,	Belchertown.
14	Sulphate of Potash,	Quinnipiac Company, Agents, New London, Conn.,	North Amherst.
	Bones.		
41	Jefferds' Steamed Bone,	J. G. Jefferds, Worcester, Mass.,	Worcester.
73	Standard Pure Ground Bone,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
87	Darling's Pure Ground Bone,	Darling Fertilizer Company, Pawtucket, R. I.,	Ipswich.
103	Lawrence Bone Meal,	Lee & Co., Lawrence, Mass.,	Lawrence.
143	S. Winter's Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.		Mechanical Analyses.			
								Total.		Available.							
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Fine.	Fine Medium.	Medium.	Coarse Medium.
	Compound Fertilizers.																
1	Ames' Bone Fertilizer,	14.05	2.88	1.65—2.47	6.81	2.04	1.51	10.36	8—12	8.85	8—10	2.10	1—3				
28	Stockbridge's Manure for Top Dressing,	11.93	3.82	5—6	5.35	5.10	0.24	10.69	6—7	10.45	3—4	6.19	5—6				
46	Chittenden's Ammon. Bone Superphosphate,	12.17	2.56	1.65—2.47	8.93	0.80	3.83	13.56	9—11	9.73	7—9	2.63	2—4				
71	Standard Superphosphate,	19.22	2.86	2.5 —3.5	4.51	3.66	2.17	10.34	11—14	8.17	9—13	3.13	3—4				
78	Economic No. 1, for Grass,	11.61	1.36	1—2	-	0.45	4.63	5.08	2—4	0.45	-	0.36	-				
105	Church's Dry Ground Fish,	11.81	9.12	-	0.59	5.64	2.34	8.57	-	6.23	-	-	-				
127	Cumberland Superphosphate,	14.17	2.60	2—3	6.88	4.43	4.48	15.79	8—14	11.31	6—10	2.56	2—3				
144	Cumberland Seeding-down Fertilizer,	18.50	2.12	1.65	2.97	5.15	11.26	19.38	18—20	8.12	5—9	0.98	1				
145	The Allen Fertilizer,	16.80	2.56	2.06—2.47	4.66	1.84	2.97	9.47	6—8	6.50	5—8	4.36	4—6				
146	Mayo's Superphosphate,	18.80	2.88	2.5—3.	6.50	3.05	0.84	10.39	11.5—13.5	9.55	10.5—11.5	3.16	3—4				
147	Davidge's Potato Manure,	20.43	3.88	2.47—3.71	7.45	3.27	1.43	12.15	-	10.72	9.5—11	3.89	4—6				
148	Special Favorite,	9.42	1.56	1.24—2.06	7.06	2.82	2.25	12.13	12—14	9.88	10—12	1.61	1.5—2.5				
14	Sulphate of Potash,	1.58	-	-	-	-	-	-	-	-	-	21.92	-				
	Bones.																
41	Jefferds' Steamed Bone,	1.50	3.28	2.47—3.30	0.46	7.60	21.75	29.81	27—30	8.06	-			57.88	31.32	10.80	-
73	Standard Pure Ground Bone,	5.60	1.36	-	0.23	7.97	19.56	27.76	-	8.20	-			42.92	23.54	12.65	10.89
87	Darling's Pure Ground Bone,	2.07	3.80	3.30	0.67	8.36	15.10	24.13	24—26	9.03	-			50.65	31.02	18.33	-
103	Lawrence Bone Meal,	15.49	2.12	-	0.20	4.40	16.35	20.95	-	4.60	-			41.69	29.49	15.92	12.90
143	S. Winter's Pure Ground Bone,	7.93	3.28	4.20	0.33	12.93	11.58	24.84	23.66	13.26	12.85			55.85	23.59	10.19	10.37

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
21	Stockbridge's Vegetable and Potato Manure,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
22	Ammoniated Bone Fertilizer,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
31	Dry Ground Fish,	Quinnipiac Company, New London, Conn.,	Northampton.
34	Mapes' Complete Manure, "A" Brand,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
45	Potato Phosphate,	Williams & Clark Company, New York,	Worcester.
50	Potato Phosphate,	Williams & Clark Company, New York,	Springfield.
51	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
56	Bradley's Fish and Potash, Anchor Brand,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
64	203 Fertilizer for General Crops,	Le Page Company, Boston, Mass.,	Boston.
70	Breck's Lawn and Garden Dressing,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
77	Randall's Bone and Potash,	Benj. Randall, Boston, Mass.,	Boston.
86	Cleveland Superphosphate,	Cleveland Dryer Company, Cleveland, Ohio,	Ipswich.
92	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
97	Crocker's Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
99	Crocker's Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
104	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
114	Soluble Pacific Guano,	Glidden & Curtis, Boston, Mass.,	Fall River.
115	Brightman's Dry Ground Menhaden Fish Guano,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
116	Brightman's Ammoniated Bone Supherphosphate,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
119	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Hatfield.
125	Americo Guano, the Standard Potato Manure,	Stearns Fertilizer Company, New York,	Worcester.
133	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York,	No. Adams.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								total.		available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
21	Stockbridge's Vegetable and Potato Manure, .	17.58	3.32	3.25—4.25	6.97	1.52	2.10	10.59	8—10	8.49	7—8	5.34	5—6
22	Ammoniated Bone Fertilizer, ...	11.70	2.12	2.00—3.00	7.43	2.80	3.38	13.61	10—12	10.23	8—10	1.71	2—3
31	Dry Ground Fish, ...	10.86	7.76	7.5—10.0	1.10	2.97	3.38	7.45	7—10	4.07	4—6	–	–
34	Mapes' Complete Manure, "A" Brand, . .	10.96	2.75	2.47—3.30	5.16	1.40	6.19	12.75	–	6.56	10—12	3.33	2.5—3.5
45 50	Potato Phosphate, ...	17.35	2.11	2.0—3.0	6.15	1.33	0.37	7.85	8—10	7.48	7—10	7.42	–*
51	Bradley's Potato Manure, ...	12.87	2.73	2.5—3.5	5.85	2.52	2.14	10.51	8—11	8.37	6—8	5.76	5—6
56	Bradley's Fish and Potash, Anchor Brand, .	10.33	3.60	3.25—4.25	2.70	1.31	1.71	5.72	5	4.01	–	3.97	3
64	203 Fertilizer for General Crops, . . .	13.73	2.59	3—4	3.03	2.83	3.53	9.39	10—12	5.86	8—10	5.40	3—4
70	Breck's Lawn and Garden Dressing, . .	7.40	4.80	4.12—4.94	5.17	1.41	1.97	8.55	–	6.58	8—9	5.10	4—6
77	Randall's Bone and Potash, ...	10.88	2.81	1.6—2.5	7.96	3.77	1.86	13.59	13—16	11.73	5—7	3.90	2
86	Cleveland Superphosphate, ...	12.40	2.72	2.05—2.85	1.60	9.47	1.47	12.47	11—14	11.07	9—11	2.16	2—3
92	Bowker's Hill and Drill Phosphate, . . .	11.27	2.54	2.5—3.25	7.77	1.53	4.84	14.14	11—14	9.30	10—12	1.83	2—3
97	Crocker's Vegetable Bone Superphosphate, .	9.91	4.60	5—6	3.43	2.49	2.49	8.41	7—10	5.92	6—8	7.15	6—8
99	Crocker's Ammoniated Wheat and Corn Phosphate, ...	12.43	2.66	2—3	8.54	3.10	0.80	12.44	11—15	11.64	10—13	4.44	1.75—2.93
104	Lowell Bone Fertilizer, ...	5.40	2.96	2—2.5	4.91	6.94	2.17	14.02	14.5—17.5	11.85	12.5—14.5	3.24	3—3.5
114	Soluble Pacific Guano, ...	12.16	3.44	2.25—3	7.29	2.79	1.41	11.49	10.5—16.0	10.08	8.5—12	3.95	2—3.5
115	Brightman's Dry Gr'nd Menhaden Fish Guano,	9.49	9.96	8.24—9.89	0.18	4.35	4.43	8.96	–	4.53	–	–	–
116	Brightman's Ammoniated Bone Superphosp'te,	11.24	3.16	2.47—4.12	4.73	1.02	4.48	10.23	8.25—10	5.75	8—10	4.14	3—5
119	Darling's Animal Fertilizer, ...	15.33	3.46	3.30—4.94	4.19	3.07	2.94	10.20	10—12	7.26	–	4.44	4—6
125	Americo Guano, the Standard Potato Manure,	10.55	4.29	4.12—5.77	1.27	8.04	3.66	13.07	8—12	9.31	–	8.60	6—8
133	High-grade Ammoniated Bone Superphosphate,	12.10	2.53	2—2.5	7.98	2.39	2.05	12.42	11—13	10.37	9—12	2.48	–*

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* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
27	Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
35	Mapes' Corn Manure,	Mapes Formula and Peruvian Guano Company, New York,	Worcester.
47	Chittenden's Complete Fertilizer,	National Fertilizer Company, Bridgeport, Conn.,	Fitchburg.
48	Flamingo Guano,	Liebig & Gibbons, Baltimore, Md.,	Fitchburg.
63	Mapes' Tobacco Manure, Conn. Brand,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
66	Red Star Brand Special Fertilizer for Onions and Tobacco,	LePage Company, Boston, Mass ,	Boston.
67	Red Star Brand, The Perfect Lawn Dressing,	LePage Company, Boston, Mass.,	Boston.
72	Breck's Top Dressing,	Standard Fertilizer Company, Duxbury, Mass.,	Boston.
81	Economic No. 4, for Potatoes,	Economic Fertilizer Company, Boston, Mass.,	Boston.
85	Cleveland Potato Phosphate,	Cleveland Dryer Company, Cleveland, O.,	Ipswich.
91	Stockbridge's Manure for Seeding-down,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
96	Bradley's XL Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Haverhill.
100	Crocker's Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
101	Crocker's Ammoniated Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Haverhill.
113	Pacific Guano Company's Special Potato Manure,	Glidden & Curtis, Boston, Mass.,	Plymouth.
117	Brightman's Fish and Potash,	W. J. Brightman & Co., Tiverton, R. I.,	Fall River.
120	World of Good Potato Grower,	Thompson & Edwards Fertilizer Company, Chicago, Ill.,	Hatfield.
126	Stearns' High-grade Ammoniated Bone Superphosphate,	Stearns Fertilizer Company, New York,	Worcester.
136	Great Eastern Grain and Grass Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
138	H. L. Phelps' Phosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
139	H. L. Phelps' Potato Manure,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
140	H. L. Phelps' Complete Manure for Corn and Grass,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
								TOTAL.		AVAILABLE.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
27	Lawn and Garden Dressing, ...	11.17	3.28	3.30—4.12	9.92	1.66	2.69	14.27	-	11.58	5—6	3.60	3—4
35	Mapes' Corn Manure, ...	12.73	4.12	3.71—4.12	5.12	3.81	3.20	12.13	10—12	8.93	-	6.29	6—7
47	Chittenden's Complete Fertilizer, . . .	12.01	2.98	3.30—4.12	4.10	6.56	3.29	13.95	8—10	10.66	6—8	5.11	6—8
48	Flamingo Guano, ...	12.35	0.80	.62—1.03	0	13.25	6.27	19.52	13—19	13.25	10—14	0.70	.25—.75
63	Mapes' Tobacco Manure, Conn. Brand, . .	4.52	4.48	4.74	4.67	3.65	4.22	12.54	7.75	8.32	-	5.89	7.75
66	Red Star Brand, Special Fertilizer for Onions and Tobacco, ...	15.46	3.32	2.47—3.30	3.74	2.46	4.13	10.33	6—8	6.20	-	4.02	-*
67	Red Star Brand, The Perfect Lawn Dressing, .	6.82	3.88	4—5	6.45	1.20	3.15	10.80	10—12	7.65	8—10	4.12	4—5
72	Breck's Top Dressing, ...	8.40	5.96	5.77—6.59	4.80	2.04	0.26	7.10	6—8	6.84	5—6	2.60	2.5—3.5
81	Economic No. 4, for Potatoes, ...	11.74	0.93	.25— .75	0	0	6.41	6.41	2—4.5	0	-	Trace.	-
85	Cleveland Potato Phosphate, ...	8.15	4.36	2.06—2.88	6.73	2.47	3.53	12.73	10—13	9.20	8—10	3.26	3.25—4.25
91	Stockbridge's Manure for Seeding-down, .	10.93	2.81	2.47—3.30	5.68	2.21	5.98	13.87	12—14	7.89	6—8	2.94	3—4
96	Bradley's XL Superphosphate of Lime, . .	15.82	2.74	2.50—3.25	8.82	1.62	1.90	12.34	11—14	10.44	9—11	1.86	2—3
100	Crocker's Potato, Hop and Tobacco Phosphate,	13.50	3.23	2—3	8.70	1.72	0.74	11.16	9—14	10.42	8—12	3.46	3.5—4.5
101	Crocker's Ammoniated Bone, ...	12.10	3.96	2.88—3.71	6.74	2.87	0.77	10.38	11—14	9.61	10—12	1.27	-*
113	Pacific Guano Co.'s Special Potato Manure, .	13.22	3.66	3.30—4.12	5.53	2.40	1.82	9.75	8—12	7.93	5—8	5.57	5.5—7
117	Brightman's Fish and Potash, ...	26.80	3.88	2.47- 4.12	0.80	7.47	2.89	11.16	-	8.27	-	2.67	2—3
120	World of Good Potato Grower, ...	8.44	2.14	2.47—3.30	3.04	5.44	5.24	13.72	-	8.48	6—8	3.06	-*
126	Stearns' High-grade Am. Bone Superphosphate,	12.50	2.68	2.26—2.88	2.84	3.10	6.26	12.20	10.5—14	5.94	8.5—11	3.12	3—4
136	Great Eastern Grain and Grass Fertilizer, .	19.47	2.56	2.88—3.71	6.52	1.73	3.20	11.45	9—15	8.25	8—12	2.67	2—4
138	H. L. Phelps' Phosphate, ...	13.35	2.92	2.47—3.30	12.72	0.24	0.24	13.20	8—10	12.96	-	3.71	3—4
139	H. L. Phelps' Potato Manure, ...	8.59	4.13	4.12—4.94	5.45	3.83	1.63	10.91	8—10	9.28	5—7	9.45	8—10
140	H.L.Phelps' Complete Manure, Corn and Grass,	8.12	4.12	4.12—4.94	5.69	2.72	1.25	9.66	8—10	8.41	8—10	9.86	7—8

* Sulphate of potash the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at—
36	Stockbridge's Manure for Onions,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
40	Lawn Fertilizer, Tobacco and Sulphur,	F. C. Sturtevant, Hartford, Conn.,	Worcester.
60	Chittenden's Complete Fertilizer for Potatoes,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
74	Peruvian Guano,	Mapes Formula and Peruvian Guano Company, New York,	Boston.
75	Animal Fertilizer for Lawn and Garden,	Darling Fertilizer Company, Pawtucket, R. I.,	Boston.
80	Economic No. 3, for Corn,	Economic Fertilizer Company, Boston, Mass.,	Boston.
89	The Economic Fertilizer for All Crops,	Baugh & Sons, Philadelphia and Baltimore,	Newburyport.
93	Stockbridge's Manure for Strawberries,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
94	Stockbridge's Manure for Grapes, Raspberries, etc.,	Bowker Fertilizer Company, Boston, Mass.,	Haverhill.
107	Baker's Special Corn Manure,	H. J. Baker & Bro., New York, N. Y.,	New Bedford.
109	Special Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	New Bedford.
112	N. Ward & Co.'s High-grade Animal Fertilizer,	N. Ward & Co., Boston, Mass.,	Boston.
121	World of Good Raw Bone Superphosphate,	Thompson & Edwards Fertilizer Company, Chicago, Ill.,	Hatfield.
130	Lister's Celebrated Onion Fertilizer,	Lister's Agricultural Chemical Works, Newark, N. J.,	Turner's Falls.
141	Fish and Potash,	Prentiss, Brooks & Co , Holyoke, Mass.,	Holyoke.
142	Lawn Dressing,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
149	Whittemore Bros.' Bone Fertilizer,	Whittemore Bros., Wayland, Mass.,	Wayland.
26	Cotton-hull Ashes,	H. L. Phelps, Southampton, Mass., Agent,	Sunderland.
37	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.

4. *Analyses of Commercial Fertilizers, etc.* — Concluded.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
36	Stockbridge's Manure for Onions,	10.29	4.00	3.25—4.25	7.37	2.37	1.90	11.64	8—10	9.74	7—8	4.85	5—6
40	Lawn Fertilizer, Tobacco and Sulphur,	22.46	2.60	-	-	-	-	0.014	-	-	-	7.12	-
60	Chittenden's Compound Fertilizer for Potatoes,	11.41	3.40	3.30—4.12	5.95	1.64	6.31	13.87	8—10	7.59	6—8	5.78	6—8
74	Peruvian Guano,	14.65	8.41	-	4.35	6.64	5.10	16.09	-	10.99	-	2.75	-
75	Animal Fertilizer for Lawn and Garden,	12.00	3.58	4—6	2.38	3.41	7.68	13.47	10—12	5.79	-	3.84	4—6
80	Economic No. 3, for Corn,	12.88	1.10	.25—.75	0.00	2.59	8.22	10.81	6—9	2.59	-	0.21	-
89	Economic Fertilizer for all Crops,	20.35	1.60	1.65—2.06	4.39	1.69	3.04	9.12	-	6.08	5—6	1.95	-*
93	Stockbridge's Manure for Strawberries,	13.37	2.18	2.50—3.25	6.06	1.06	6.56	13.68	7—9	7.12	6—7	3.92	-*
94	Stockbridge's Manure for Grapes, etc.,	13.70	3.18	2.50—3.25	7.16	1.15	3.29	11.60	8—10	8.31	6—8	3.58	4—5
107	Baker's Special Corn Manure,	8.04	4.58	4.12	4.89	1.56	2.07	8.52	7.50—9.50	6.45	6.50	7.32	7
109	Special Grass Manure,	15.12	3.68	3.30	4.16	0.62	2.00	6.82	-	4.78	5	5.80	7
112	N. Ward & Co., High-grade Animal Fertilizer,	14.86	3.69	2.88—3.70	5.46	6.22	0.50	12.18	-	11.68	12—14	4.15	4—5
121	World of Good Raw Bone Superphosphate,	4.72	3.04	1.65—2.47	5.14	4.29	6.28	15.71	12—14	9.43	8—10	2.10	-*
130	Lister's Celebrated Onion Fertilizer,	10.11	4.52	3.30—4.12	4.34	3.10	0.32	7.76	-	7.44	8—10	5.75	7—8
141	Fish and Potash,	7.60	3.65	3.30—4.12	2.12	1.63	1.48	5.23	5—6	3.75	-	5.12	4—6
142	Lawn Dressing,	15.21	2.92	3.30—4.12	5.94	1.22	0.50	7.66	6—8	7.16	-	8.09	7—9
149	Whittemore Bros.' Bone Fertilizer,	13.13	3.70	-	5.62	6.53	1.47	13.62	-	12.15	-	3.63	-
26	Cotton-hull Ashes,	10.70	-	-	-	-	-	10.08	-	-	-	26.04	-
37	Nitrate of Soda,	1.32	16.04	-	-	-	-	-	-	-	-	-	-

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* Sulphate of potash the source of potash.

5. *Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.*

Wood Ashes.

[I., II. and III. sent on from Amherst, Mass.; IV. sent on by E. C. Smith, Rowley, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.49	9.30	0.44	7.03
Calcium oxide,	38.36	38.58	24.62	32.31
Magnesium oxide,	2.74	2.72	4.70	4.03
Sodium oxide,	2.29	1.89	–	–
Potassium oxide,	4.53	4.84	5.69	4.36
Phosphoric acid,	2.48	2.99	4.61	2.38
Insoluble matter (before calcination),	17.54	18.08	41.92	19.53
Insoluble matter (after calcination),	14.51	15.36	37.22	13.99

Wood Ashes.

[I. and II. sent on by C. H. Thompson & Co., Boston, Mass.; III. sent on by J. C. Comins, N. Amherst, Mass.; IV. sent on by Chas. N. Perley, Danvers, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.03	0.55	6.98	7.72
Calcium oxide,	22.69	33.58	37.28	42.39
Magnesium oxide,	6.15	3.74	5.13	2.65
Potassium oxide,	6.52	1.91	5.56	5.38
Phosphoric acid,	1.66	1.32	2.30	1.15
Insoluble matter (before calcination),	27.92	3.64	13.91	9.26
Insoluble matter (after calcination),	23.75	2.03	11.50	6.37

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by Frank Wheeler, Concord, Mass.; III. and IV. sent on by E. W. McGarvey, London, Ont.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C., ...	16.55	15.58	7.53	11.88
Calcium oxide, ...	36.59	34.20	39.61	34.87
Magnesium oxide, ...	3.01	2.86	2.42	3.20
Potassium oxide, ...	4 29	4.82	6.39	5.29
Phosphoric acid, ...	2.44	1 76	1.28	2.00
Insoluble matter (before calcination),	15.15	20.75	11.14	11 66
Insoluble matter (after calcination), .	12.42	18.35	8.32	7.68

Wood Ashes.

[Sent on by Frank Goodwin, Framingham, Mass.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C , ...	20.33	15.54	.10	14.34
Calcium oxide, ...	31.21	32.77	40.01	33.82
Magnesium oxide, ...	3.51	3.21	3.73	3.04
Potassium oxide, ...	3.57	3.75	9.80	4.43
Phosphoric acid, ...	2.90	1.45	2.16	2.72
Insoluble matter (before calcination);	13.31	12.56	15.54	21.13
Insoluble matter (after calcination), .	10.51	10 06	11.94	8.69

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. sent on by Frank Goodwin, Framingham, Mass.; II. sent on by Chas. W. Jenks, Bedford, Mass.; III. sent on by Frank E. Kimball, Danvers, Mass.; IV. sent on by C. N. Perley, Danvers, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	.15	20.40	15.64	14.46
Calcium oxide,	44.59	30.98	31.56	32.14
Magnesium oxide,	7.24	3.14	3.27	2.59
Potassium oxide,	4.27	4.26	4.12	4.36
Phosphoric acid,	3.73	1.54	1.28	2.71
Insoluble matter (before calcination),	11.70	13.53	24.10	16.48
Insoluble matter (after calcination),	10.42	10.49	13.50	13.26

Wood Ashes.

[I. sent on from Amherst, Mass.; II. sent on by Urbane Derby, Concord, Mass.; III. sent on by W. E. Allen, Lancaster, Mass.; IV. sent on by E. F. Manchester, Fall River, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	19.30	7.08	.25	4.77
Calcium oxide,	30.54	39.54	27.48	32.52
Magnesium oxide,	2.75	4.64	4.41	4.60
Potassium oxide,	5.16	3.60	5.07	4.23
Phosphoric acid,	1.77	1.95	2.28	2.07
Insoluble matter (before calcination),	14.50	14.74	39.10	24.76
Insoluble matter (after calcination),	10.20	12.53	37.75	20.04

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by J. A. Merriam, Framingham, Mass.; III. sent on by R. L. Day, South Framingham, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	19.04	21.47	14.52
Calcium oxide,	36.35	32.66	40.31
Magnesium oxide,	2.82	2.36	2.91
Potassium oxide,	4.63	3.26	2.70
Phosphoric acid,	1.65	1.70	1.47
Insoluble matter (before calcination),	8.07	8.25	7.77
Insoluble matter (after calcination),	7.15	7.86	6.78

Wood Ashes.

[I. sent on by W. H. Davis, Littleton, Mass.; II. and III. sent on by A. H. Turner, Harvard, Mass.; IV. sent on by Flagg & Russell, Warnersville, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	2.42	15.72	13.88	11.45
Calcium oxide,	36.94	28.61	34.03	27.17
Magnesium oxide,	3.24	3.00	3.07	3.37
Ferric oxide,	2.74	1.03	.49	–
Potassium oxide,	7.82	8.72	5.59	5.77
Phosphoric acid,	.51	.32	.54	1.31
Insoluble matter (before calcination),	16.43	18.49	13.51	7.08
Insoluble matter (after calcination),	12.18	12.12	11.33	5.85

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I. and II. sent on by Coolidge Bros., South Sudbury, Mass ; III. and IV. sent on by James Logan, Worcester, Mass.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C , ...	15.73	11.86	24.96	15.97
Calcium oxide, ...	37.18	43.13	15.83	39.76
Magnesium oxide, ...	3.56	1.80	2.14	1.82
Potassium oxide, ...	5 22	3.66	3.74	2.40
Phosphoric acid, ...	1.57	3.84	1.89	6.10
Insoluble matter (before calcination),	6.44	7.06	16.20	8.39
Insoluble matter (after calcination), .	5 61	6.41	12.50	5 93

Cotton-seed Hull Ashes.

[I. sent on by Lyman A. Crafts, Whately, Mass.; II. sent on by S. G. Hubbard, Whately, Mass.; III. sent on by A. W. Field, North Hadley, Mass.; IV. sent on by J. Comins, Sunderland, Mass.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C , ...	10.24	9.97	.86	11.96
Calcium oxide, ...	8.89	9.59	9.80	4.41
Magnesium oxide, ...	12.61	13.58	16.05	12.29
Ferric oxide, ...	1.14	1.54	1.92	–
Potassium oxide (6 cents per pound), .	28.44	25.17	22.58	29.36
Phosphoric acid (6 cents per pound), .	10.28	9.16	8.02	12 99
Insoluble matter (before calcination),	–	–	10.73	7.38
Insoluble matter (after calcination), .	6.11	.96	6.50	3 68
Valuation per ton, ...	$46 46	$41 20	$36 72	$50 82

5. *Analyses, etc.* — Continued.

Cotton-seed Hull Ashes.

[I. and II. sent on by S. G. Hubbard, Hatfield, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	8.13	8.13
Calcium oxide,	7.26	11.34
Magnesium oxide,	10.99	11.58
Ferric oxide,	1.25	1.96
Potassium oxide (6 cents per pound),	25.35	22.66
Phosphoric acid (6 cents per pound),	10.68	8.69
Insoluble matter (before calcination),	13.59	12.70
Insoluble matter (after calcination),	11.61	9.73
Valuation per ton,	$43 24	$37 62

Sulphate of Potash.

[I. sent on from Amherst, Mass.; II. and III. sent on from Feeding Hills, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	4.87	7.54	8.46
Potassium oxide (6 cents per pound),	37.54	25.81	17.43
Sulphuric acid,	45.96	46.96	50.11
Insoluble matter,	.94	–	–
Valuation per ton,	$45 05	$30 97	$20 92

5. *Analyses, etc.* — Continued.

Muriate of Potash.

[Sent on from Amherst, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	4.01	2.22	2.41
Sodium oxide,	2.88	12.44	11.50
Potassium oxide (4½ cents per pound),	45.16	47.30	49.86
Chlorine,	45.67	52.00	52.00
Insoluble matter,	1.01	Trace.	Trace
Valuation per ton,	$40 64	$42 57	$44 87

Gypsum.

[I. sent on from Wellesley Hills, Mass.; II. sent on from Amherst, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	38.47	14.05
Calcium oxide,	16.21	32.65
Sulphuric acid,	21.43	41.90
Insoluble matter,	11.30	2.22

No. I. is a factory refuse article.

Lime.

[Sent on from Amherst, Mass.]

	Per Cent.
Calcium oxide,	74.79
Insoluble matter,	.77

5. *Analyses, etc.* — Continued.

South Carolina Phosphate.

[Sent on from Amherst, Mass. I., finely ground "Floats;" II., Apatite.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	.39	.09
Calcium oxide,	46.76	–
Ferric and aluminic oxides,	5.78	–
Total phosphoric acid,	27.57	36.08
Soluble phosphoric acid,	0.00	–
Reverted phosphoric acid (7½ cents per pound),	4.27	–
Insoluble phosphoric acid (2 cents per pound),	23.30	–
Insoluble matter,	9.04	9.55
Valuation per ton,	$15 73	–

Mona Island Guano.

[Sent on by J. Campbell & Co., New York, N. Y.]

	Per Cent.
Moisture at 100° C,	12.52
Ash,	75.99
Total phosphoric acid,	21.88
Soluble phosphoric acid,	.00
Reverted phosphoric acid (7½ cents per pound),	7.55
Insoluble phosphoric acid (3 cents per pound),	14.33
Calcium oxide,	37.49
Potassium oxide,	Trace.
Nitrogen (17 cents per pound),	.76
Insoluble matter,	2.45
Valuation per ton,	$22 50

5. *Analyses, etc.* — Continued.

Dissolved Bone-black.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	16.84	17.41
Ash,	56.83	56 19
Total phosphoric acid,	22.18	21.70
Soluble phosphoric acid,	14.27	15.60
Reverted phosphoric acid,	7.53	6.02
Insoluble phosphoric acid,	.38	.08
Insoluble matter,	3.92	3.99
Valuation per ton,	$34 59	$34 10

Bone Coal.

[Sent on by Chas. S. Young, Wellesley Hills, Mass.]

	Per Cent.
Moisture at 100° C.,	18 16
Ash,	72.24
Total phosphoric acid,	25.58
Soluble phosphoric acid (8 cents per pound),	.38
Reverted phosphoric acid (7½ cents per pound),	5.18
Insoluble phosphoric acid (5 cents per pound),	20.02
Insoluble matter,	.69
Valuation per ton,	$28 40

5. *Analyses, etc.* — Continued.

Ground Bones.

[I., II. and III. sent on by Geo. Frost, Boston, Mass.; IV. sent on by L. B. Smith, Eastham, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	28.96	56.50	33.25	50.78
Fine medium, smaller than $\frac{1}{25}$ inch,	59.98	38.18	28.65	49.22
Medium, smaller than $\frac{1}{12}$ inch,	11.06	5.32	21.78	–
Coarser than $\frac{1}{12}$ inch,	–	–	16.32	–
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	5.59	5.85	4.18	5.34
Ash,	58.07	38.79	49.80	64.17
Total phosphoric acid,	20.08	19.90	19.32	27.22
Soluble phosphoric acid,	.30	.17	.37	.54
Reverted phosphoric acid,	5.46	7.86	9.36	9.34
Insoluble phosphoric acid,	14.32	12.67	9.59	17.34
Nitrogen,	3.88	5.90	4.72	–
Insoluble matter,	1.48	.48	.40	.46

5. *Analyses, etc.* — Continued.

Bones.

[I. sent on by Edward H. Smith, Northborough, Mass.; II. sent on by Franklyn Howland, New Bedford, Mass.; III. sent on by Edmund Hersey, Hingham, Mass.; IV. sent on by S. Winter, Brockton, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine, smaller than $\frac{1}{50}$ inch,	37.90	46.00	62.29	57.33
Fine medium, smaller than $\frac{1}{25}$ inch,	38.30	36.52	30.81	24.13
Medium, smaller than $\frac{1}{12}$ inch,	19.50	17.48	6.28	9.74
Coarser than $\frac{1}{12}$ inch,	4.30	–	.62	8.80
	100.00	100.00	100.00	100.00

Chemical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	4.33	4.21	5.07	8.03
Ash,	57.06	74.04	55.04	60.60
Total phosphoric acid,	22.40	29.42	25.19	23.66
Soluble phosphoric acid,	.43	.45	.14	.51
Reverted phosphoric acid,	6.17	13.17	10.80	12.18
Insoluble phosphoric acid,	15.80	15.80	14.25	10.97
Nitrogen,	4.04	2.08	3.07	4.20
Insoluble matter,	1.65	.31	.55	.72

Dried Blood.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	15.02
Nitrogen (19 cents per pound),	8.24
Valuation per ton,	$31 31

5. *Analyses, etc.* — Continued.

Sulphate of Ammonia.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.43
Nitrogen (19 cents per pound),	20.91
Sulphuric acid,	57.26
Valuation per ton,	$79 46

Nitrate of Soda.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.22	1.98
Sodium oxide,	53.44	59.56
Nitrogen (17 cents per pound),	15.30	16.00
Insoluble matter,	.19	.05
Valuation per ton,	$52 02	$54 40

Saltpetre Waste (from Gunpowder Works).

[Sent on by A. N. Stowe, Hudson, Mass.]

	Per Cent.
Moisture at 100° C.,	2.12
Calcium oxide,	.22
Magnesium oxide,	.16
Sodium oxide,	50.54
Potassium oxide (4½ cents per pound),	1.85
Sulphuric acid,	.71
Nitrogen (17 cents per pound),	.59
Chlorine,	59.00
Insoluble matter,	.18
Valuation per ton,	$3 68

5. *Analyses, etc.* — Continued.

Wool Waste.

[I. sent on by F. D. Barker, South Acton, Mass.; II. sent on by C. W. Mann, Methuen, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	8.53	3.46
Ash,	–	59.41
Potassium oxide (4¼ cents per pound),	Trace.	3.08
Phosphoric acid (6 cents per pound),	.115	.29
Nitrogen (8 cents per pound),	10.195	1.18
Insoluble matter,	3.480	49.57
Valuation per ton,	$16 45	$4 86

"*Mud Crab.*"

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	7.67
Ash,	6.71
Total phosphoric acid (6 cents per pound),	1.25
Soluble phosphoric acid,	.28
Reverted phosphoric acid,	.62
Insoluble phosphoric acid,	.35
Nitrogen (17 cents per pound),	8.84
Insoluble matter,	.91

Tobacco Dust.

[Sent on from Syracuse, N. Y.]

	Per Cent.
Moisture at 100° C.,	12.98
Potassium oxide (4¼ cents per pound),	9.04
Phosphoric acid (6 cents per pound),	2.09
Nitrogen (17 cents per pound),	3.00
Insoluble matter,	.40
Valuation per ton,	$20 39

5. *Analyses, etc.* — Continued.

Cotton-seed Meal.

[Sent on from Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	5.77	6.27	8.44
Calcium oxide,	.38	.42	.378
Magnesium oxide,	.98	1.07	1.200
Potassium oxide (4¼ cents per pound),	.87	.96	2 017
Phosphoric acid (6 cents per pound),	1.42	1.57	3.165
Nitrogen (15 cents per pound),	5.96	6.56	7.220
Insoluble matter,	.59	.73	.121
Valuation per ton,	$20 32	$22 37	$27 17

Gluten Meal.

[Sent on by W. E. Dennis, Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	7.850
Calcium oxide,	.045
Magnesium oxide,	.042
Ferric oxide,	.090
Sodium oxide,	.111
Potassium oxide (4¼ cents per pound),	.030
Phosphoric acid (6 cents per pound),	.501
Nitrogen (17 cents per pound),	6.060
Insoluble matter,	1.680
Valuation per ton,	$21 23

5. *Analyses, etc.* — Continued.

Linseed Refuse.

[Sent on by John King, South Framingham, Mass.]

	Fine.	Coarse.
Moisture at 100° C.,	6.440	6.230
Ash,	7.370	5.330
Potassium oxide (4¼ cents per pound),	.679	.802
Phosphoric acid (6 cents per pound),	1.525	1.188
Nitrogen (15 cents per pound),	7.080	4.680
Insoluble matter,	.495	.112
Valuation per ton,	$28 84	$22 29

Cotton-seed Fertilizer.

[Sent on by Geo. W. Wright, Concord, Mass.]

	Per Cent.
Moisture at 100° C.,	7.950
Calcium oxide,	.429
Magnesium oxide,	.672
Ferric oxide,	.066
Potassium oxide (4¼ cents per pound),	1.194
Phosphoric acid (6 cents per pound),	1.241
Nitrogen (15 cents per pound),	8.000
Insoluble matter,	1.187
Valuation per ton,	$26 50

Oak Leaves.

[Sent on by W. H. Hillman, Forestdale, Mass.]

	Per Cent.
Moisture at 100° C.,	9.601
Ash,	6.840
Calcium oxide,	.548
Magnesium oxide,	.267
Ferric oxide,	.027
Potassium oxide (4¼ cents per pound),	.058
Phosphoric acid (6 cents per pound),	.549
Nitrogen (17 cents per pound),	.930
Soluble silica,	.018
Insoluble silica,	4.333
Valuation per ton,	$3 87

5. *Analyses, etc.* — Continued.

Chaff from Grain Elevator.

[Sent on by S. H. Pierce, Lincoln, Mass.]

	Per Cent.
Moisture at 100° C.,	9.89
Ash,	10.74
Potassium oxide (4¼ cents per pound),	.76
Phosphoric acid (6 cents per pound),	5.00
Nitrogen (17 cents per pound),	1.62
Insoluble matter,	6.49
Valuation per ton,	$12 16

Jute Waste.

[Sent on by J. E. Stevens, Ludlow, Mass.]

	Per Cent.
Moisture at 100° C.,	10.847
Ash,	23.610
Calcium oxide,	1.496
Ferric oxide,	.671
Potassium oxide (4¼ cents per pound),	.080
Phosphoric acid (6 cents per pound),	.720
Nitrogen (13 cents per pound),	1.794
Insoluble matter,	19.090
Valuation per ton,	$5 59

Hemp Waste.

[Sent on by J. E. Stevens, Ludlow, Mass.]

	Per Cent.
Moisture at 100° C.,	12.272
Ash,	6.340
Calcium oxide,	1.654
Ferric oxide,	.307
Potassium oxide (4¼ cents per pound),	.232
Phosphoric acid (6 cents per pound),	.242
Nitrogen (13 cents per pound),	1.095
Insoluble matter,	2.481
Valuation per ton,	$3 26

Cranberry Vines.

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	13.070
Ash,	2.450
Calcium oxide,	.404
Magnesium oxide,	.253

5. *Analyses, etc.* — Continued.

	Per Cent.
Ferric oxide,	.087
Sodium oxide,	.080
Potassium oxide (4¼ cents per pound),	.329
Phosphoric acid (6 cents per pound),	.268
Nitrogen (17 cents per pound),	.770
Insoluble matter,	.834
Valuation per ton,	$3 22

Salt Hay.

[Sent on by L. B. Smith, Eastham, Mass.]

	Per Cent.
Moisture at 100° C.,	5.360
Calcium oxide,	.371
Magnesium oxide,	.335
Ferric oxide,	.028
Sodium oxide,	.017
Potassium oxide (4¼ cents per pound),	.718
Phosphoric acid (6 cents per pound),	.248
Nitrogen (17 cents per pound),	1.180
Valuation per ton,	$4 92

Compound Fertilizers.

[I. sent on by H. D. Graves, Sunderland, Mass.; II. sent on by S. G. Hubbard, Whately, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	14.17	8.92
Total phosphoric acid,	15.79	6.86
Soluble phosphoric acid,	6.88	4.77
Reverted phosphoric acid,	4.43	1.58
Insoluble phosphoric acid,	4.48	.51
Potassium oxide,	2.56	10.31
Nitrogen,	2.60	6.82
Insoluble matter,	5.44	3.67

5. *Analyses, etc.* — Continued.

Compound Fertilizers.

[I. sent on by C. A. Bartlett, Worcester, Mass.; II. sent on by E. C. Smith, Rowley, Mass.; III. sent on by W. H. Porter, Agawam, Mass.; IV. sent on by F. W. J. Gerrish, North Worcester, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	17.92	8.71	6.41	18.97
Ash,	56.65	60.15	72.65	48.25
Total phosphoric acid,	7.87	16 71	15.04	11.03
Soluble phosphoric acid,	3.55	4.53	5.44	7.16
Reverted phosphoric acid,	1.99	3.67	4.29	3.42
Insoluble phosphoric acid,	2.33	8.51	5.31	.45
Potassium oxide,	3.78	4.70	2.16	3.56
Nitrogen,	2.06	3.12	2.42	2.24
Insoluble matter,	9.93	5.55	7.50	5.30

Barn-yard Manure.

[Sent on from Amherst.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	73.470	73.520	76.160	73.470
Organic and volatile matter,	85.900	93.087	95.915	96.671
Ash,	14.100	6.913	4.085	3.329
Calcium oxide,	.264	.185	.302	.322
Magnesium oxide,	.182	.158	.180	.124
Potassium oxide (4½ cents per pound),	.615	.487	.804	.484
Phosphoric acid (6 cents per pound),	.133	.189	.218	.247
Nitrogen (17 cents per pound),	.362	.338	.570	.471
Insoluble matter,	12.657	6.038	2.131	2.285
Valuation per ton,	$1 94	$1 82	$2 92	$2 34

5. *Analyses, etc.* — Concluded.

Barn-yard Manure.

[Sent on from Amherst.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	70.160	56.710	72.810
Organic volatile matter,	86.553	87.526	95.809
Ash,	13.447	12.474	4.191
Calcium oxide,	.323	.386	–
Magnesium oxide,	.271	.223	–
Potassium oxide (4½ cents per pound),	.614	.486	.562
Phosphoric acid (6 cents per pound),	.553	.399	.745
Nitrogen (17 cents per pound),	.486	.419	.672
Insoluble matter,	11.991	9.873	2.250
Valuation per ton,	$2 86	$2 34	$3 68

No. III. From State Experiment Station.

6. *Miscellaneous Analyses.*

Ensilage Liquor.

[Sent on by James Cheesman, Boston, Mass. Specific gravity, 1.015; temperature, 17° C.]

	Per Cent.
Acidity (calculated to acetic acid),	2.66
Moisture at 100° C.,	96.21
Dry matter,	3.79
Ash,	.91
Calcium oxide,	.015
Magnesium oxide,	.003
Ferric oxide,	.227
Sodium oxide,	.001
Potassium oxide,	.155
Phosphoric acid,	.001
Nitrogen as ammoniates,	.023
Nitrogen as nitrates,	.008
Nitrogen as albuminoids,	.002
Nitrogen, total,	.056

6. *Miscellaneous Analyses* — Concluded.

"*Nicotinia*" (*Insecticide*).

[Sent on from Syracuse, N. Y.]

	Per Cent.
Moisture at 100° C.,	10.00
Ash,	27.37
Calcium oxide,	4.45
Magnesium oxide,	.90
Potassium oxide (4¼ cents per pound),	9.15
Phosphoric acid (6 cents per pound),	.67
Nitrogen (17 cents per pound),	2.49
Insoluble matter,	2.12
Valuation per ton,	$17 05

Hellebore (*Insecticide*).

[Sent on by Joseph Breck & Son, Boston, Mass.]

	Per Cent.	
	I.	II.
Ash,	6.97	41.36
One hundred parts of ash contained: —		
Ferric and aluminic oxides,	–	7.11
Insoluble matter,	33.65	92.16

No. II. was evidently adulterated with ground clay.

Peroxide of Silicate (*Insecticide*).

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	1.65
Calcium oxide,	41.18
Sulphuric acid,	49.66
Arsenious oxide,	.57
Copper oxide,	.33
Insoluble matter,	2.31

Gypsum, with a trace of Paris green.

II. ANALYSES OF WATER SENT ON FOR EXAMINATION.

[Parts per million.]

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1,	.03	.06	Trace.	41.00	11.00	1.11	None.	Upton.
2,	.02	.07	5.00	45.00	10 00	1.27	None.	Amherst.
3,	.10	.14	13.00	157.00	89.00	3.25	None.	Amherst.
4,	.04	.15	32.00	203.00	118.00	3.25	None.	Amherst.
5,	.02	.04	11.00	96.00	24.00	1.27	Present.	Framingham.
6,	.05	.08	12.00	108.00	30.00	2.60	None.	Framingham.
7,	.02	.01	10.00	72.00	44.00	2.73	-	Hinsdale.
8,	.03	.07	9.00	160.00	85.00	3.25	None.	Amherst.
9,	.02	.04	24.00	146.00	46.00	3.12	None.	Amherst.
10,	.68	.18	Trace.	45.00	5.00	1.27	None.	Amherst.
11,	.12	.04	6.00	25.00	5.00	0.00	-	Ashfield.
12,	.08	.04	Trace.	68.00	28.00	2.86	-	Ashfield.
13,	.03	.06	7.00	58.00	40.00	0.00	None.	Bedford.
14,	.04	.28	22.00	135.00	70.00	3.38	None.	Westford.
15,	.05	.18	20.00	85.00	20.00	3.38	-	Westford.
16,	.99	.15	96.00	558.00	325.00	13.01	None.	South Deerfield.
17,	.03	.07	Trace.	70.00	45.00	1.56	None.	North Amherst.
18,	.03	.07	30.00	85.00	18.00	2.60	Present.	Amherst.
19,	.04	.07	Trace.	93.00	30.00	3.90	None.	Amherst.
20,	.04	.12	Trace.	60.00	30.00	0.00	None.	Ashby.
21,	.03	.09	4.00	130.00	68.00	2.73	None.	East Amherst.
22,	.03	.05	7.00	91.00	43.00	.79	None.	North Leverett.
23,	01	.05	10.00	60.00	15.00	.32	Present.	Shutesbury.
24,	.52	1.80	40.00	765.00	410.00	9.71	-	Amherst.
25,	.40	.12	7.00	92.00	22.00	6.43	Present.	Amherst.
26,	.01	.01	78.00	389.00	139.00	7.83	-	Amherst.
27,	.46	.07	Trace.	57.00	12.00	2.60	None.	Amherst.
28,	.33	.08	Trace.	74.00	27.00	2.34	Present.	Amherst.
29,	.03	.06	12.00	135.00	70.00	3.64	None.	Amherst.

II. ANALYSES OF WATER — Continued.

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
30,	.01	.06	Trace.	112.00	42.00	2.47	None.	East Amherst.
31,	.04	.05	Trace.	46.00	10.00	.47	None.	Amherst.
32,	.13	.10	6.00	147.00	92.00	4.57	None.	South Amherst.
33,	.17	.06	6.00	111.00	66.00	4.57	None.	Amherst.
34,	.84	.10	34.00	370.00	137.00	6.71	None.	Sunderland.
35,	·05	.05	6.00	88.00	42.00	2.21	–	Amherst.
36,	.01	.03	8.00	180.00	80.00	3.90	None.	Leverett.
37,	.01	.01	Trace.	30.00	00.00	1.11	None.	Amherst.
38,	.01	.10	12.00	95.00	5.00	1.95	–	Amherst.
39,	.01	.16	Trace.	49.00	10.00	2.34	None.	South Boston.
40,	.05	.12	Trace.	47.00	9.00	2.34	None.	South Boston.
41,	.03	.03	7.00	93.00	51.00	2.73	None.	Amherst.
42,	.21	.07	3.00	61.00	25.00	2.21	None.	North Amherst.
43,	.02	.07	22.00	168.00	78 00	4.57	None.	Amherst.
44,	.03	.16	Trace.	52.00	12.00	.32	–	Amherst.
45,	.05	.03	Trace.	74.00	18.00	1.95	None.	South Amherst
46,	.06	.13	8.00	128.00	68.00	2.60	Present.	Amherst.
47,	.01	.12	Trace.	40.00	6.00	.32	–	Amherst.
48,	.03	.10	Trace.	42.00	20.00	.32	–	Amherst.
49,	.03	.11	10.00	158.00	90.00	2.34	–	Amherst.
50,	.01	.04	Trace.	50.00	38.00	1.27	None.	Amherst.
51,	.03	.24	Trace.	50.00	8.00	.16	–	Amherst.
52,	.14	.22	Trace.	140.00	86.00	4.57	–	Amherst.
53,	.01	.06	5.00	110.00	90.00	2.34	None.	Amherst.
54,	.10	.26	6.00	74.00	42.00	4.16	None.	Hudson.
55,	.72	.16	13.00	156.00	98.00	5.29	–	Amherst.
56,	.06	.26	7.00	68.00	22 00	.79	None.	Ashburnham.
57,	.12	.08	10.00	90.00	30.00	2.60	–	Bedford.
58,	.08	.08	35.00	210.00	160.00	5.29	Present.	Bedford.
59,	.00	.04	8.00	77.00	47.00	2.21	–	Bedford.

II. ANALYSES OF WATER — Concluded.

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
60,	.01	.03	8.00	70.00	35.00	1.95	None.	Bedford.
61,	.01	.06	6.00	75.00	40.00	.48	None.	East Deerfield.
62,	.00	.03	4.00	20.00	00.00	.00	None.	East Deerfield.
63,	.01	.02	8.00	75.00	40.00	2.21	None.	North Amherst.
64,	.02	.07	7.00	138.00	78.00	1.56	None.	Deerfield.
65,	.01	.03	21.00	178.00	150.00	2.60	None.	Amherst.
66,	.09	.05	19.00	68.00	50 00	2.60	None.	Amherst.
67,	.01	.05	7.00	78.00	18.00	.48	None.	North Hadley.
68,	.08	.06	11.00	114 00	56.00	2.86	None.	East Buckland.
69,	.03	.10	10.00	96.00	68.00	2.99	–	Buckland.
70,	.05	.07	17.00	280.00	190.00	2.86	–	Sunderland.
71,	.06	.05	20.00	236.00	146.00	4.57	None.	Amherst.
72,	Trace.	.02	10.00	88.00	26.00	1.95	None.	North Amherst.
73,	.01	.05	6.00	40.00	18.00	1.43	None.	North Amherst.
74,	Trace.	.03	4.00	16.00	6 00	.16	None.	North Amherst.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per

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* One gallon equals 70,000 grains.

million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

The American Association of Official Chemists has appointed a committee to investigate the subject of analyses of water for family use, and to advise upon some uniform method of investigation and of reporting the results. As soon as their recommendation shall be endorsed by the association, we propose to be guided by that decision.

An examination of the previously stated results of analyses, indicate that Nos. 3, 5, 10, 11, 16, 18, 23, 24, 25, 27, 28, 32, 33, 34, 42, 46, 52, 54, 57 and 58, ought to be condemned as unfit for family use, while Nos. 12, 56, 66 and 68 must be considered suspicious. From this record it will be seen that over one-fourth of the entire number of well waters tried proved unfit for drinking. Heating well waters to the boiling point removes, not unfrequently, immediate danger. Seven samples gave unmistakable evidence of the presence of lead.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by W. H. Beal.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1890.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1889, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	NITROGEN.			POTASH.			TOTAL PHOSPHORIC ACID.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse Salts, Ashes, etc.																							
Muriate of potash,	45	2.00	-	-	-	-	58.98	45.94	**52.46**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.60	.75
Sulphate of potash,	15	1.25	-	-	-	-	51.28	21.36	**38.60**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia,	13	4.75	-	-	-	-	27.77	18.92	**23.50**	-	-	-	-	-	-	6.25	2.57	12.25	-	44.25	-	2.60	1.41
Kainite,	3	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.12	10.25	-	21.05	-	34.32	1.27
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.57	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (*Kieserite*),	9	22.20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	14	1.40	-	16.01	15.30	**15.75**	-	-	-	-	-	-	-	-	-	35.25	-	-	-	-	-	.50	.50
Sulphate of ammonia,	23	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	trace
Saltpetre waste,	8	2.75	-	3.30	.59	**2.43**	30.94	1.85	**15.50**	-	-	-	-	-	-	34.25	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake,	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	116	12.00	-	-	-	-	7.95	2.93	**5.25**	4.61	.51	**1.75**	-	-	-	-	34.80	3.25	.83	-	-	-	12.50
Cotton-seed hull ashes,	20	7.33	-	-	-	-	42.12	17.34	**23.80**	13.67	2.89	**8.50**	-	-	-	-	9.50	11.25	1.60	-	-	-	11.79
Ashes of spent tan-bark,	3	6.31	-	-	-	-	2.87	1.14	**2.04**	2.77	.13	**1.61**	-	-	-	-	33.46	3.55	-	-	-	-	24.33

Logwood ashes,	1	1.50	-	-	-	-	-	-	**.08**	-	-	**2.30**	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	**10.16**	-	-	**2.24**	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	**1.60**	-	-	**.46**	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue-works,	1	12.74	63.78	-	-	-	-	-	**9.02**	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	**.92**	-	-	**.30**	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	**.22**	-	-	**2.25**	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	7	15.45	-	-	-	-	1.70	.02	**.86**	3.16	.36	**1.18**	-	-	-	-	44.80	2.60	-	-	17.75	-	8.25
Marls (Massachusetts),	5	18.18	-	-	-	-	-	-	-	2.72	.06	**1.05**	-	-	-	-	40.07	.64	.69	-	28.51	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	**.49**	.09	.08	**.09**	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	**.04**	-	-	**.56**	-	-	-	-	21.95	.61	-	-	-	-	50.18
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	**7.85**	4.08	1.14	**2.61**	20.60	5.96	**15.26**	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano, from Texas,	9	40.09	18.24	10.51	2.58	**6.47**	-	-	**1.31**	6.53	1.00	**3.76**	-	-	-	-	-	-	-	-	-	-	2.00
Cuba guano,	5	24.27	.67	2.74	.63	**1.67**	-	-	-	16.16	11.54	**13.35**	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (*Orchilla*),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	**26.77**	-	-	-	-	39.95	3.29	-	2.08	-	-	1.27
South Carolina rock phosphate,	4	1.50	-	-	-	-	-	-	-	30.51	25.81	**28.03**	.27	.33	27.43	-	41.87	3.03	4.80	-	-	-	11.61
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	**34.27**	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	**35.21**	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	3	1.45	-	-	-	-	-	-	-	30.51	18.91	**23.49**	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40

	Analyses.	Moisture.	Ash.	NITROGEN.			POTASH.			TOTAL PHOSPHORIC ACID.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
II. Guanos, Phosphates, etc.—Concluded.																							
Bone-black,	5	4.60	–	–	–	–	–	–	–	30.54	16.56	28.28	–	–	–	–	–	–	–	–	–	–	3.64
South American bone-ash,	1	7.00	–	–	–	–	–	–	–	–	–	35.89	–	–	–	–	44.89	–	–	–	–	–	4.50
III. Refuse Substances.																							
Dried blood,	12	12.50	6.37	13.55	8.10	10.52	–	–	–	6.23	1.53	1.91	–	–	–	–	–	–	–	–	–	–	–
Ammonite,	1	5.88	–	–	–	11.33	–	–	–	–	–	3.43	–	–	–	–	–	–	–	–	–	–	1.38
Oleomargarine refuse,	1	8.54	14.42	–	–	12.12	–	–	–	–	–	.88	–	–	–	–	–	–	–	–	–	–	.96
Felt refuse,	1	29.24	33.53	–	–	5.26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	8.44
Sponge refuse,	1	7.25	–	–	–	2.43	–	–	–	–	–	3.19	–	–	–	–	3.94	1.27	–	–	–	–	39.05
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	–	–	–	2.30	1.36	1.83	–	–	–	–	–	–	–	–	–	–	.24
Raw wool,	1	6.95	7.54	–	–	12.88	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.63
Wool waste,	5	9.27	–	10.20	1.18	5.64	3.08	.54	1.30	–	–	.29	–	–	–	–	.07	.07	–	–	–	–	4.60
Wool washings (water),	1	–	–	–	–	–	–	–	3.92	–	–	–	–	–	–	.49	.28	–	–	–	–	–	–
Wool washings (acid),	1	–	–	–	–	–	–	–	4.20	–	–	–	–	–	–	.40	.61	.20	–	–	–	–	–
Wool washings (alkaline),	1	92.03	3.28	–	–	.09	–	–	1.09	–	–	–	–	–	–	.92	.04	–	–	–	–	–	.22

Meat mass,	5	12.09	13.60	11.50	9.69	10.44	–	–	–	3.58	.56	2.07	–	–	–	–	–	–	–	–	–	–	.58
Bone soup,	1	82.92	7.07	–	–	1.14	–	–	–	–	–	1.26	–	–	–	–	–	–	–	–	–	–	–
Dried soup from meat and bone,	1	14.80	8.40	–	–	9.97	–	–	–	–	–	.53	–	–	–	–	–	–	–	–	–	–	.61
Dried soup from rendering cattle feet,	1	10.80	7.50	–	–	14.47	–	–	–	–	–	.46	–	–	–	–	–	–	–	–	–	–	.26
Dried soup from horse rendering,	1	92.14	–	–	–	1.12	–	–	–	–	–	.14	–	–	–	–	–	–	–	–	–	–	–
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	–	–	–	15.37	11.04	13.21	–	–	–	–	–	–	–	–	–	–	1.29
Bones,	106	7.47	56.07	4.70	1.62	4.12	–	–	–	27.76	18.58	23.50	.43	7.85	15.22	–	–	–	–	–	–	–	1.25
Tankage,	13	13.20	28.75	8.07	4.60	6.82	–	–	–	16.94	8.76	11.25	.27	4.75	6.23	–	–	–	–	–	–	–	1.23
Fish with less than 20 per cent. water,	49	12.75	21.50	11.40	6.81	7.25	–	–	–	11.26	5.50	8.25	.55	2.50	5.10	–	–	–	–	–	–	–	2.20
Fish with between 20 and 40 per cent. water,	9	29.34	19.14	7.41	4.22	5.81	–	–	–	8.32	4.68	7.25	.82	2.87	3.56	–	–	–	–	–	–	–	1.85
Fish with over 40 per cent. water,	10	45.46	15.50	7.60	2.43	4.97	–	–	–	8.56	2.94	5.08	1.17	1.33	2.58	–	–	–	–	–	–	–	1.35
Whale meat, raw,	1	44.50	1.04	–	–	4.86	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lobster shells,	1	7.27	–	–	–	4.50	–	–	–	–	–	3.52	–	–	–	–	22.24	1.30	–	–	–	–	.27
Castor-bean pomace,	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	–	–	–	–	.87	.29	–	–	–	–	1.75
Cotton-seed meal,	7	6.80	5.77	7.26	4.02	6.66	2.09	.89	1.62	3.16	1.26	1.45	–	–	–	–	.39	.99	–	–	–	–	.60
Rotten brewer's grain,	1	78.77	–	–	–	.72	–	–	.04	–	–	.43	–	–	–	–	.26	.15	–	–	–	–	.59
Tobacco stems,	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	–	–	–	.34	3.89	1.23	–	–	–	–	.82
Cotton waste (wet),	1	34.69	–	–	–	1.30	–	–	.80	–	–	1.54	–	–	–	–	2.45	1.13	–	–	–	–	41.33
Cotton waste (dry),	2	6.89	–	2.09	1.32	1.71	1.62	.89	1.26	.84	.83	.84	–	–	–	–	1.99	.77	–	–	–	–	34.89
Cotton dust,	1	34.46	50.93	–	–	.50	–	–	.19	–	–	.21	–	–	–	–	.90	.90	–	–	–	–	47.46
Glucose refuse,	1	8.10	–	–	–	2.62	–	–	.15	–	–	.29	–	–	–	–	.18	.02	–	–	–	–	.07
Hop refuse,	1	8.98	–	–	–	.98	–	–	.11	–	–	.20	–	–	–	–	.27	.10	–	–	–	–	.63

	Analyses.	Moisture.	Ash.	NITROGEN.			POTASH.			TOTAL PHOSPHORIC ACID.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances — Concluded.																							
Sumac waste,	1	63.06	6.80	–	–	**1.19**	–	–	**3.25**	–	–	–	–	–	–	–	1.14	3.25	–	–	–	–	2.25
Eel-grass,	2	35.39	15.60	.96	.70	**.83**	1.61	.21	**.91**	.41	.22	**.32**	–	–	–	1.63	2.13	.11	–	–	–	–	1.06
Rockweed, green,	1	68.50	23.70	–	–	**.62**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rockweed, dry,	1	10.68	35.75	–	–	**1.45**	–	–	**4.89**	–	–	**2.75**	–	–	–	7.90	7.66	.21	–	–	–	–	10.40
Wet kelp,	1	88.04	2.26	–	–	**.26**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Mussel mud, wet,	1	60.01	27.29	–	–	**.21**	–	–	**6.17**	–	–	**.10**	–	–	–	.70	.93	.14	3.48	–	–	–	–
Mussel mud, dry,	1	2.24	72.02	–	–	**.72**	–	–	–	–	–	**.35**	–	–	–	–	23.39	–	8.26	–	–	–	37.60
Salt mud,	2	53.37	41.19	.40	.39	**.40**	.33	.32	**.33**	–	–	–	–	–	–	.94	.91	.37	4.13	–	–	–	34.88
Fresh-water mud,	1	40.37	–	–	–	**1.37**	–	–	**.22**	–	–	**.26**	–	–	–	–	1.27	.29	1.80	–	–	–	18.26
Black mud,	1	56.55	39.60	–	–	**1.64**	–	–	**.38**	–	–	–	–	–	–	.86	.91	.66	4.26	–	–	–	31.84
Muck,	12	55.13	13.75	2.54	.26	**1.12**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Peat,	9	61.50	7.71	1.40	.41	**.75**	–	–	–	–	–	–	–	–	–	–	.50	–	–	–	–	–	.38
Turf,	1	19.29	6.36	1.97	1.91	**1.94**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Soot,	1	5.54	77.10	–	–	–	–	–	**1.83**	–	–	–	–	–	–	–	–	–	–	–	–	–	35.34

IV. Animal Excrement.																							
Barn-yard manure,	7	73.27	8.36	.67	.34	**.47**	.80	.48	**.58**	.75	.13	**.36**	–	–	–	–	.30	.19	–	–	–	–	6.75
Poudrette, dry,	1	5.25	35.45	–	–	**3.58**	–	–	**.49**	–	–	**5.74**	–	–	–	–	–	–	–	–	–	–	4.65
Hen manure, fresh,	1	45.73	–	–	–	**.79**	–	–	**.18**	–	–	**.47**	–	–	–	–	.97	–	–	–	–	–	39.32
Hen manure, dry,	1	8.35	–	–	–	**2.13**	–	–	**9.94**	–	–	**2.02**	–	–	–	–	2.22	.62	–	–	–	–	34.64

COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

1868-1890.

Prepared by W. H. Beal.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

A. Analyses of Fodder Articles.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN—													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN—FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	23	30.53	10.34	19.14	17.19	8.04	10.33	6.10	1.42	2.42	63.13	42.02	55.30	31.53	19.26	25.97	5.98	1:7.99
Fodder corn (ensilaged),	16	28.40	13.12	20.30	12.58	6.91	8.64	6.07	1.94	3.84	65.69	42.99	56.44	35.25	17.67	26.29	4.99	1:10.22
Sorghum,	6	23.18	12.38	17.41	11.84	7.46	8.74	2.00	1.21	1.55	64.93	47.65	56.15	29.27	22.00	26.73	6.83	1:11.62
White kibi,*	2	24.26	22.85	23.56	15.14	10.79	12.97	1.61	1.50	1.56	53.66	52.30	52.91	31.70	23.03	27.37	5.19	-
Mochi millet,*	3	42.27	30.07	37.42	11.90	6.11	9.94	1.94	1.74	1.81	67.08	49.06	55.69	29.80	20.01	25.56	7.00	-
Mix,*	3	31.36	18.17	24.45	16.70	9.81	13.53	2.48	1.35	1.86	52.30	47.75	51.27	27.44	26.82	27.06	6.28	-
Green oats,	5	28.82	15.51	20.03	20.47	7.05	13.85	3.32	2.02	2.68	50.69	40.81	45.90	33.12	25.2	29.70	7.87	1:9.97
Timothy (*Phleum pratense* L.),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.27	33.23	32.50	32.87	5.33	1:10.96
Hungarian grass (*Setaria Itālica* Beauv.),	1	-	-	25.93	-	-	9.38	-	-	1.01	-	-	57.80	-	-	24.66	7.15	1:6.86
Vetch and oats (1 part vetch, 9 parts oats),	2	24.04	13.89	18.97	10.76	10.59	10.68	2.74	2.29	2.52	43.75	40.10	41.91	35.81	34.20	35.01	9.88	1:6.85
Horse bean (*Vicia faba* L.),	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75	1:2.71
Cow-pea vines,	3	21.19	18.15	19.63	17.93	11.24	14.59	2.99	1.81	2.48	60.62	46.13	52.42	25.88	21.87	23.59	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	2	19.42	15.40	17.41	17.75	12.17	14.96	2.65	2.09	2.37	41.54	35.45	38.49	38.76	26.21	32.49	11.69	1:4.67
White lupine (*Lupinus albus* L.),	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03	-
Spanish moss (*Tillandsia usneoides* L.),	1	-	-	39.20	-	-	4.45	-	-	2.54	-	-	57.73	-	-	32.61	2.67	-

II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	5	91.94	89.11	**90.28**	10.13	9.02	**9.54**	2.65	2.09	**2.49**	54.43	47.11	**49.26**	35.55	29.21	**32.28**	6.43	1:11.85
Rowen (of mixed hay),	4	91.16	80.29	**86.10**	14.70	11.63	**13.45**	5.03	2.60	**3.91**	53.52	41.92	**45.48**	31.50	25.11	**28.88**	8.28	1:6.36
Timothy hay (*Phleum pratense* L.),	4	92.76	89.45	**91.43**	9.02	7.24	**8.32**	2.65	1.95	**2.20**	54.43	50.01	**51.73**	36.59	29.21	**32.90**	4.85	1:11.44
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	**92.30**	8.40	6.41	**7.88**	1.69	1.50	**1.60**	54.74	50.32	**52.63**	34.11	31.12	**32.92**	4.97	1:12.06
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	**91.17**	11.29	7.57	**8.99**	3.56	2.40	**2.91**	47.34	43.50	**46.15**	35.79	34.12	**34.89**	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	4	92.60	87.84	**90.18**	7.27	5.89	**6.49**	2.17	1.65	**1.84**	49.18	43.95	**47.37**	39.90	34.46	**36.26**	8.04	1:14.32
Perennial rye grass (*Lolium perenne* L.),	4	93.64	90.50	**92.60**	16.56	6.59	**11.71**	3.15	1.59	**2.37**	55.77	38.82	**48.14**	30.86	26.79	**29.64**	8.14	1:7.40
Italian rye grass (*Lolium Italicum* A Br.),	4	92.62	90.70	**91.54**	9.75	6.20	**8.15**	2.07	1.39	**1.85**	52.80	43.09	**49.14**	36.90	31.27	**33.34**	7.52	1:10.90
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	**92.55**	–	–	**9.45**	–	–	**2.22**	–	–	**50.64**	–	–	**31.96**	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	–	–	**93.35**	–	–	**15.27**	–	–	**1.95**	–	–	**38.24**	–	–	**33.72**	10.82	1:2.94
Low meadow hay,	1	–	–	**91.99**	–	–	**9.51**	–	–	**1.88**	–	–	**46.27**	–	–	**35.59**	6.75	–
Millet,	5	93.85	91.90	**93.00**	8.11	7.09	**7.59**	2.67	.89	**1.74**	55.80	49.62	**51.64**	35.91	29.80	**33.54**	5.49	1:7.78
Oats in blossom,	1	–	–	**93.57**	–	–	**6.58**	–	–	**2.92**	–	–	**50.03**	–	–	**34.06**	6.41	1:14.23
Oats in milk,	1	–	–	**90.45**	–	–	**10.89**	–	–	**2.69**	–	–	**46.02**	–	–	**34.32**	6.08	1:7.90
Oats, ripe,	1	–	–	**91.30**	–	–	**6.05**	–	–	**2.61**	–	–	**48.92**	–	–	**36.31**	6.11	1:15.03
Winter rye, in bloom,	1	–	–	**91.45**	–	–	**10.66**	–	–	**2.57**	–	–	**47.40**	–	–	**32.97**	6.40	1:8.28
Barley, in milk,	1	–	–	**89.75**	–	–	**10.26**	–	–	**2.76**	–	–	**52.91**	–	–	**29.12**	4.95	1:9.59
Corn fodder,	3	93.35	91.17	**92.62**	8.63	6.17	**7.21**	2.06	1.11	**1.53**	55.68	53.86	**54.98**	33.75	29.05	**31.40**	4.88	1:11.85
Corn stover,	11	94.23	49.87	**81.08**	12.15	6.04	**7.92**	2.63	1.17	**1.65**	63.05	44.65	**53.38**	38.24	20.93	**32.02**	5.03	1:10.88

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* Japanese fodder plants.

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN — PROTEIN.			FAT.			NITROGEN — FREE EXTRACT.			FIBRE.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodder — Concluded.																		
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	-	-	93.94	-	-	9.71	-	-	1.28	-	-	53.18	-	-	28.88	6.95	-
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	1	-	-	93.98	-	-	14.63	-	-	2.62	-	-	43.88	-	-	29.97	8.90	1:5.63
Alsike clover (*Trifolium hybridum* L.),	5	93.92	86.48	90.07	17.55	14.77	16.22	3.26	1.88	2.66	46.64	38.03	43.27	32.34	21.44	26.18	11.67	1:3.37
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.30	34.39	25.42	29.72	8.11	1:4.09
Sand lucerne, in bloom (*M. media* Pers.),	1	-	-	91.20	-	-	16.26	-	-	2.59	-	-	50.31	-	-	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	1	-	-	93.64	-	-	11.81	-	-	1.85	-	-	51.36	-	-	28.08	6.90	-
Blue melilot (*Melilotus cærulea* Desr.),	1	-	-	91.78	-	-	13.81	-	-	1.67	-	-	43.22	-	-	27.17	14.87	-
Sulla (*Hedysarum coronarium*),	1	-	-	89.54	-	-	17.03	-	-	3.16	-	-	58.66	-	-	12.38	8.77	-
Hairy lotus (*Lotus villosus* Thuill.),	2	89.32	87.64	88.48	16.12	13.49	14.81	3.00	2.69	2.85	57.82	50.80	54.29	24.48	15.07	19.78	8.27	-
Soja bean,	2	93.88	93.52	93.70	15.87	15.10	15.49	6.35	5.62	5.99	51.28	48.25	49.75	21.75	20.76	21.26	7.51	1:4.52
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.93	23.58	19.06	21.67	9.29	1:4.82
Serradella,	3	92.80	87.23	90.44	17.97	15.26	17.03	2.91	2.37	2.55	50.23	44.49	48.18	25.92	24.37	25.15	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	-	-	92.56	-	-	19.58	-	-	1.22	-	-	38.95	-	-	31.88	8.37	-
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.80	30.68	30.05	30.37	8.24	1:3.87
Vetch and oats,	1	-	-	87.47	-	-	7.72	-	-	2.53	-	-	49.00	-	-	36.22	4.53	1:11.26

Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55
White daisy (*Chrysanthemum Leucanthemum* L.),	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Dry carrot tops,	1	-	-	90.24	-	-	20.12	-	-	2.01	-	-	50.39	-	-	13.61	13.87	-
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58	1:8.24
Beets, sugar,	9	19.53	13.05	15.62	17.44	7.32	10.84	.83	.58	.65	81.50	72.79	77.87	6.98	4.82	6.00	4.64	1:12.15
Beets, yellow fodder,	1	-	-	9.40	-	-	12.78	-	-	1.80	-	-	67.50	-	-	7.83	10.09	1:8.33
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.75	9.54	7.08	7.94	9.06	1:9.94
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	2	12.80	8.23	10.52	10.81	9.67	10.24	1.74	1.42	1.58	70.62	68.80	69.71	10.96	10.12	10.54	7.93	1:13.07
Carrots,	3	12.52	9.95	10.82	9.63	7.98	8.84	3.94	1.67	2.50	73.96	67.24	70.99	10.76	7.55	9.53	8.14	1:9.81
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	28	91.98	65.50	89.55	15.02	8.49	12.24	9.43	4.25	5.47	83.98	71.06	78.44	3.38	1.03	2.14	1.71	1:8.16
Corn kernels and cobs (corn and cob meal),	8	90.55	73.66	85.12	15.06	7.82	11.13	5.27	3.36	4.24	80.87	70.13	75.62	9.77	5.39	7.34	1.67	1:8.63
Wheat grain,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.26	-	-	2.42	2.18	1:6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Soja beans (*Soja hispida* Mönch.),	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans (*Vicia faba* L.),	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24

A. Analyses of Fodder Articles — Concluded.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN — FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver	Max.	Min.	Aver.		
V. Flour and Meal.																		
Corn meal,	18	89.95	82.96	87.24	16.08	10.19	11.26	5.08	3.10	4.35	83.24	73.20	80.34	3.60	1.20	2.42	1.63	1:8.94
Hominy meal,	3	91.89	89.30	90.75	11.88	11.20	11.61	12.22	4.89	9.33	78.07	68.00	72.55	4.78	3.69	4.08	2.43	1:8.82
Ground barley,	2	87.81	86.39	87.10	11.17	10.42	10.80	2.19	1.69	1.94	78.25	77.45	77.79	7.37	6.85	7.11	2.36	1:9.72
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	-
VI. By-products and Refuse.																		
Linseed cake, old process,	4	92.52	89.54	90.82	38.67	30.98	36.26	7.98	5.69	6.83	44.72	37.76	41.02	9.69	8.04	8.73	7.16	1:1.67
Linseed cake, new process,	2	93.99	91.42	92.71	40.76	32.50	36.63	3.18	3.14	3.16	46.49	40.83	42.66	10.31	9.23	9.77	6.78	1:1.45
Cotton-seed meal,	7	93.16	90.11	91.92	47.04	18.17	42.22	14.72	5.22	13.48	54.55	25.03	28.02	14.80	6.28	8.22	8.06	1:1.45
Wheat bran,	20	91.90	86.30	89.30	20.24	15.67	17.56	6.08	2.80	4.83	62.18	56.89	59.87	14.26	7.49	10.83	6.91	1:3.85
Wheat middlings,	3	90.75	89.45	90.45	19.21	17.23	18.21	6.46	3.19	4.63	74.30	61.62	69.60	8.40	1.40	4.11	3.45	1:4.10
Wheat shorts,	2	91.13	89.67	90.40	17.28	16.71	17.00	5.86	5.52	5.69	61.71	58.03	59.86	11.21	8.58	9.90	7.55	1:4.09
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.70	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Gluten meal,	17	92.15	88.32	90.36	39.28	28.24	31.58	9.34	3.92	6.59	66.26	48.84	60.19	4.74	.41	1.12	.59	1:2.39
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-

Spent brewer's grain,	1	-	-	93.02	-	-	20.49	-	-	1.95	-	-	55.51	-	-	15.90	6.15	1:3.06
Cocoa dust, from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.19	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	-
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.2	72.56	16.58	13.15	14.86	1.46	-
Apple-pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar-beet pulp, from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. *Analyses of Fodder Articles, with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
I. Green Fodders.												
Corn fodder,	4	72.64	.564	1.64	.620	.102	.312	.132	.042	.281	.703	$2 78
Corn fodder, ensilage,	1	71.60	.360	1.32	.330	.050	.100	.090	.020	.140	.040	1 68
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	2 09
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 65
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 38
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	2 14
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 58
Horse bean,	1	74.71	.675	1.45	1.370	.090	1.370	.620	.200	.330	2.040	3 87
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 51
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 92
White lupine,	1	85.35	.440	.74	1.730	.680	3.070	.730	.170	.350	.900	3 39
Spanish moss (*Tillandsia*),	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 20
II. Hay and Dry Coarse Fodders.												
English hay (mixed hays),	3	11.26	1.370	6.34	1.541	.077	.401	.197	.045	.352	.890	6 38
Rowen,	2	12.48	1.746	9.57	1.966	.168	.814	.250	.064	.464	1.920	8 16

Timothy hay,	2	7.52	1.260	4.93	1.530	.220	.710	.100	–	.460	1.170	6 14
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.362	1.736	5 20
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 55
Meadow fescue,	4	9.79	.942	7.88	2.005	.225	.566	.160	.030	.343	1.883	5 31
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	6 16
Italian rye grass,	2	8.29	1.150	6.89	.992	.595	1.072	.306	.098	.552	2.899	5 41
Salt hay,	1	5.36	1.180	–	.718	.017	.371	.335	.028	.248	–	4 92
Corn fodder,	4	–	1.800	4.91	.760	.010	.600	.690	.070	.510	1.650	7 38
Corn stover,	2	28.24	1.118	3.74	1.320	.794	.524	.257	.056	.303	.811	5 28
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 72
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	9 38
Medium red clover,	1	10.72	2.089	8.36	2.201	.192	1.838	.402	.061	.436	.254	9 49
Alsike clover,	5	9.93	2.331	11.11	2.008	.317	2.209	.537	.216	.703	1.746	10 46
Lucerne (*alfalfa*),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 92
Bokhara clover,	1	6.36	1.770	6.46	1.673	.077	1.938	.373	.025	.436	.013	7 96
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	9 55
Sulla,	1	10.46	2.441	7.85	1.872	.362	2.791	.378	.147	.424	.987	10 40
Lotus villosus,	1	12.36	2.259	7.32	1.550	.633	2.861	.615	.148	.500	1.053	9 50
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	9 54
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	6 96
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	10 64
Vetch and oats,	2	11.98	1.368	10.96	.903	.199	.539	.253	.137	.525	.212	6 05

B. *Analyses of Fodder Articles, with Reference to Fertilizing Ingredients* — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per Ton of 2,000 Pounds.
II. Hay and Dry Coarse Fodders — Concluded.												
White daisy,	1	9.65	**.279**	6.37	**1.253**	.164	1.302	.191	.032	**.435**	1.110	$2 54
Dry carrot tops,	1	9.76	**3.130**	12.52	**4.883**	4.028	2.089	.667	.118	**.612**	.098	15 52
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	**.243**	1.13	**.436**	.091	.049	.033	.004	**.091**	.020	1 31
Beets, sugar,	2	84.65	**.250**	.80	**.285**	.151	.056	.037	.018	**.083**	.066	1 19
Beets, yellow fodder,	1	90.60	**.192**	.95	**.462**	.104	.045	.030	.005	**.086**	.015	1 14
Mangolds,	2	87.29	**.188**	1.22	**.383**	.125	.061	.039	.005	**.093**	.023	1 06
Ruta-bagas,	2	87.82	**.210**	1.10	**.500**	.100	.090	.030	.003	**.131**	.010	1 30
Turnips,	1	87.20	**.221**	1.01	**.412**	.133	.117	.033	.009	**.116**	.072	1 22
Carrots,	1	90.02	**.140**	.88	**.540**	.110	.070	.020	.010	**.100**	.010	1 06
Potatoes,	1	79.75	**.207**	.99	**.294**	.013	.007	.020	.002	**.066**	.006	1 03
Apples,	2	79.91	**.130**	.41	**.190**	.030	.030	.030	.003	**.010**	.003	49
IV. Grains and Other Seeds.												
Corn kernels,	13	10.88	**1.822**	1.53	**.404**	.034	.032	.206	.019	**.699**	.020	6 37
Corn kernels and cobs (cob meal),	4	10.00	**1.460**	1.45	**.441**	.121	.057	.162	.004	**.603**	.091	6 05
Soja beans,	2	18.33	**5.303**	4.99	**1.991**	.275	.419	.909	.216	**1.869**	.093	21 96

V. Flour and Meal.												
Corn meal,	2	13.52	**2.05**	1.42	**.435**	.064	.034	.187	.015	**.707**	.005	7 85
Hominy feed,	1	8.93	**1.63**	2.21	**.490**	-	.180	.280	-	**.980**	-	6 14
Ground barley,	1	13.43	**1.55**	2.06	**.341**	.169	.091	.173	.013	**.660**	.669	6 25
Wheat flour,	1	9.83	**2.21**	1.22	**.540**	-	.170	.050	-	**.570**	-	8 65
Pea meal,	1	8.85	**3.08**	2.68	**.993**	.618	.302	.302	.027	**.820**	.122	11 31
VI. By-products and Refuse.												
Linseed cake, old process,	3	7.79	**6.021**	7.13	**1.162**	-	.656	.799	.060	**1.646**	.355	23 44
Linseed cake, new process,	2	6.12	**5.396**	5.33	**1.160**	-	.552	.534	.047	**1.420**	.152	21 02
Cotton-seed meal,	6	8.36	**6.41**	6.27	**1.620**	.190	.710	1.100	.190	**2.090**	.501	25 68
Wheat bran,	4	11.01	**2.88**	6.44	**1.620**	.180	.200	.900	.020	**2.870**	.130	14 77
Wheat middlings,	1	9.18	**2.63**	2.30	**.630**	.110	.200	.210	-	**.950**	-	10 63
Rye middlings,	1	12.54	**1.84**	3.52	**.810**	.030	.090	.320	.020	**1.260**	.170	8 46
Gluten meal,	4	8.53	**5.43**	.65	**.045**	.018	.050	.035	.069	**.425**	-	19 01
Spent brewer's grain,	1	6.98	**3.05**	6.15	**1.550**	.347	.296	.286	.159	**1.260**	1.770	12 14
Cocoa dust,	1	7.10	**2.299**	6.35	**.630**	-	.630	-	-	**1.340**	-	11 22
Broom-corn waste (stalks),	1	10.37	**.870**	4.70	**1.858**	-	.242	.170	-	**.460**	1.000	5 09
Cotton hulls,	3	10.63	**.750**	2.61	**1.080**	-	.200	.260	-	**.180**	.060	3 74
Apple pomace,	2	80.50	**.227**	.271	**.134**	.026	.037	.028	.008	**.018**	.009	90
Corn cobs,	8	12.09	**.504**	.815	**.598**	.071	.025	.045	.009	**.063**	.190	2 44
Palmetto root,	1	11.51	**.540**	3.93	**1.380**	.345	.045	.004	.017	**.157**	.410	3 20

NOTE.— Basis of valuation, nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4¼ cents per pound.

C. *Analyses of Fruits.*

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Grape Sugar in Juice.	Cane Sugar in Juice.	*Soda sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12—15	3.09	–	–	–
Apple (Baldwin), ...	Oct. 9,	19.66	1.065	12—15	6.25	–	–	–
Apple (Baldwin), ...	Nov. 27,	–	1.075	12—15	10.42	–	–	–
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	12—15	3.16	–	–	–
Rhode Island Greening, . .	Oct. 9,	19.68	1.066	12—15	7.14	–	–	–
Rhode Island Greening,† . .	Nov. 27,	20.25	1.080	12—15	11.36	–	–	–
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	12—15	4.77	–	–	–
Pear (Bartlett), ...	Sept. 7,	16.55	1.060	12—15	5.68	–	–	–
Pear (Bartlett), ...	Sept. 20,	–	1.065	12—15	8.62	–	–	–
Pear (Bartlett),‡	Sept. 22,	–	1.060	12—15	8.93	–	–	–
Cranberries, ...	–	10.71	1.025	15	1.35	–	–	–§
Cranberries, ...	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe), . .	–	–	1.045	25	–	1.92	6.09	45
Early York Peach (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe), .	–	–	1.050	18	–	2.19	7.02	85.6
Crawford Peach (mellow), .	–	11.36¶	1.055	18	–	1.70	8.94	76
Crawford Peach (not mellow), .	–	11.88¶	1.045	22	–	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2 25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Grape Sugar in Juice.	Sugar in Dry Matter.	* Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord, ...	July 17,	1.0175	31	8.30	.645	7.77	–
Concord, ...	July 20,	1.0150	31	8.10	.625	7.72	216
Concord, ...	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord, ...	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord, ...	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord, ...	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord, ...	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Purple Wild Grape, . . .	July 19,	1.020	31	9.00	.714	7.93	204
Purple Wild Grape, . . .	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Purple Wild Grape, . . .	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Purple Wild Grape, . . .	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape, . . .	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific, ...	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' Seeding, ...	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona, ...	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed), ...	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam, ...	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder, ...	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware, ...	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak, ...	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella, ...	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling, ...	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack, ...	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba, ...	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder, ...	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak, ...	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord, ...	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord, ...	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan, ...	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape, . . .	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled), .	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled), .	Sept. 20,	1.045	16	16.69	8.22	49.25	104

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* One part of pure $Na_2 CO_3$ in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Grape Sugar in Juice.	Sugar in Dry Matter.	*Soda Solution required to neutralize 100 parts of Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled,	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled,	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained —			Soda Solution required for 100 parts of Grapes.
		Ash.	Moisture.	Grape Sugar.	
	1889.				
Concord, not girdled,	Sept. 23,	–	84.69	6.24	75
Concord, girdled,	Sept. 23,	.42	83.00	8.13	85.4
Concord, not girdled,	Oct. 8,	.53	84.51	6.09	48
Concord, girdled,	Oct. 8,	.37	82.69	8.50	50

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* One part $Na_2 CO_3$ to 100 parts of water.

C. Analyses of Fruits — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Grape Sugar.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	–	–	8.03	–	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	–	–	13.51	–	Fertilized.
Wild Purple Grape Juice, . .	"	–	1.045	16	8.22	9.840	Unfertilized.
Wild Purple Grape Juice, . .	"	–	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	–	–	–	–	Unfertilized.
Wild White Grape Berries, .	"	21.65	–	–	–	–	Fertilized.
Wild White Grape Juice, . .	"	–	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, . .	"	–	–	–	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	–	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. Analyses of Fruits — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 Parts of Ash contained —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit), . .	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice, . .	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice, . .	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp, . . .	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds, ...	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes, . . .	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches, * . .	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine, † . . .	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Clinton Grape (fruit), . .	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple, ...	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit), ‡ . .	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit), § . .	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines, . . .	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit), . . .	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines, . . .	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red, ...	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white, . . .	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound, . .	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased, ‖ .	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound, . . .	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased, ‖ . .	–	15.67	–	64.23	10.28	1.45	8.37	–
Asparagus stems, . . .	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots, . . .	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions, ...	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	¾ to ⅞	15.50
II. Vilmorin, ...	Saxony, .	¾ to 1	15.61
I. White Imperial, ...	Saxony, .	¾ to 1¾	14.20
II. White Imperial, ...	Saxony, .	1¾ to 2	10.27
New Imperial, ...	Saxony, .	1¼ to 1¾	13.80
I. White Magdeburg, . . .	Saxony, .	1½ to 2	13.10
II. White Magdeburg, . . .	Silesia, .	1½ to 1¾	10.06
Quedlinburg, ...	Saxony, .	1½ to 1¾	13.44
White Silesian, ...	Silesia, .	1¼ to 1½	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard-manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	Fresh yard-manure, .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard-manure and chemicals, . . .	12.75	9.17	3.58	71.92
Warm alluvial, .	Fresh hog-manure, .	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard-manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . . .	12.55	13.24	10.50
Kainite and superphosphate, . .	13 15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable-manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

LOCALITY OF BEET-FIELD.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y.,	1872–73	11	7.80	3.20
2. Washington, N. Y.,	"	14	10.97	3.03
3. South Hartford, N. Y.,	"	15	11.70	3.30
4. Greenwich, N. Y.,	"	12	9.50	2.50
5. Frankfort, N. Y.,	"	13.5	11.00	2 50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 lbs. † From beets weighing from 10 to 14 lbs.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

WHERE GROWN.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal,	2 to 2½ lbs.	15.4°	64° F.	11.38
Reviere du Loup,	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly,	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge,	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Grape Sugar.	Cane Sugar.	Soda Solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15, .	No flower stalks in sight,* . .	4.2	27	2.48	None	6.8	7.93
Aug. 16, .	No flower stalks in sight,* . .	5.8	24	4.06	None	9.0	11.10
Aug. 20, .	Flower stalks developed,* . .	7.9	24	3.47	2.15	7.0	13.00
Aug. 24, .	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27, .	Plants in full bloom,* . . .	10.0	25	3.65	4.13	10.0	15.48
Aug. 30, .	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2, .	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9, .	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9, .	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18, .	Left on field without stripping,* .	13.2	22	3.57	7.65	–	–
Sept. 18, .	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18, .	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18, .	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21, .	Juice from the above,* . . .	13.0	21	–	–	–	–
Sept. 23, .	Juice from the above,* . . .	15.0	18	–	–	–	–
Sept. 25, .	Left on field 3 weeks,† . . .	19.8	21	11.91	6.27	–	–
Sept. 28, .	Left on field 3 weeks,† . . .	17.8	12	16.60	–	–	–
Oct. 4, .	Left on field 3 weeks,† . . .	16.1	17	8.62	6.16	12.0	–
Oct. 7, .	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8, .	Freshly cut. Stripped 2 weeks,† .	12.8	17	5.16	5.27	7.0	–
Oct. 9, .	Freshly cut. Stripped 2 weeks,† .	18.4	17	7.57	–	10.6	–
Oct. 14, .	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18, .	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19, .	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22, .	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23, .	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24, .	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 PARTS OF CANE CONTAINED —				
		Moisture.	Grape Sugar.	Cane Sugar.	Total Sugar.	
1879.						
October, .	Early Tennessee sorghum, mature, .	77.43	1.79	3.21	5.00	Grown on station grounds.
October, .	Price's new hybrid, ripe, . . .	77.80	2.92	3.78	6.70	
October, .	Kansas orange, green, . . .	80.67	2.38	3.63	6.01	
October, .	New orange, green, ...	78.30	2.96	3.85	6.81	
October, .	Honduras, green, ...	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Grape Sugar in Juice.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn, *	1.023	27	4.35	.28	15.18
Black Mexican sweet corn, †	1.048	27	2.06	7.02	17.44
Evergreen sweet corn, †	1.052	–	4.85	5.70	20.38
Common sweet corn, ‡	1.035	–	6.60	None.	–
Common yellow musk-melon, §	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
Red-flesh water-melon,	1.025	19	3.84	1.77	–
Nutmeg musk-melon, ‖	1.030	19	3.33	2.11	–
Nutmeg musk-melon, ¶	1.050	20	2.27	5.38	–
Nutmeg musk-melon, **	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. *Analyses of Dairy Products.*

	Analyses.	Solids.			Fat.			Curd.			Salt.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	50	16.70	11.96	13.60	5.45	2.48	3.95	–	–	3.20	–	–	–	.70
Skim-milk,	–	–	–	10.19	–	–	.37	–	–	3.53	–	–	–	.80
Buttermilk,	–	–	–	8.16	–	–	.21	–	–	2.79	–	–	–	.80
Cream,	54	28.51	22.65	25.03	20.90	13.74	16.99	–	–	–	–	–	–	.62
Butter,	24	92.89	87.05	89.17	89.05	81.43	83.98	.89	.51	.66	6.45	3.61	4.80	–
Whole-milk cheese (Jersey),*	1	–	–	62.84	–	–	37.32	–	–	22.13	–	–	–	3.39
Whole-milk cheese,*	1	–	–	64.17	–	–	34.34	–	–	26.69	–	–	–	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	–	–	62.70	–	–	27.81	–	–	30.37	–	–	–	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	–	–	57.76	–	–	23.42	–	–	31.99	–	–	–	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	–	–	56.05	–	–	17.67	–	–	33.24	–	–	–	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	–	–	54.59	–	–	15.77	–	–	34.94	–	–	–	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	–	–	51.62	–	–	18.35	–	–	28.63	–	–	–	4.64
Genuine oleomargarine cheese,*	1	–	–	62.10	–	–	31.66	–	–	25.94	–	–	–	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	–	–	–	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	3.16	.356	.140	–	–	–	
Solar salt from Kansas,	4.950	93.060	1.220	–	.240	.350	.180	–	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	–	.080	.390	None.	–	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	–	–	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	–	–	.072	
Ashton salt (sent on),	.760	97.650	1.430	–	.060	–	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	–	–	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.046	–	–	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	–	–	.700	

METEOROLOGY.

1889.

Our weather observations have been conducted on the same general plan as in previous years, being essentially the same as that recommended to voluntary observers of the United States Signal Service. Besides this, we have during the summer months forwarded to a signal officer at Cambridge, Mass., a weekly report of temperature, rainfall and sunshine, and their effects as observed on the growth of crops in this vicinity. This report was for use of the New England Meteorological Society and the United States Signal Service in preparing a weekly weather and crop bulletin.

The winter months of 1889 were exceptionally mild. Our lowest temperature during that time was nine degrees below zero. Ice did not form thick enough to be cut until the first part of February. There was no snow on the ground until the 20th of January. Sleighs were in use from that date until the last week in February; most of the time, however, hardly enough snow for good sleighing. A snow-storm, amounting to 4.5 inches, occurred on March 31 and April 1. This snow quickly disappeared.

On account of the warm and dry weather during the spring, the ground was prepared and planted somewhat earlier than usual. Heavy frosts occurred May 4 and 29: the latter touched our more tender crops, but apparently did not affect corn or potatoes.

February, March and April were our driest months; less than three inches of water fell during February and March. The rains of May were abundant and well distributed. During June, July and the first part of August, an unusual number of rainy days interfered seriously with farm work; considerable damage was done in our vicinity to partially cured hay and grain.

The average temperature of July and August was lower than usual. The cool weather during those two months retarded the ripening of corn, and was evidently injurious to most crops, judging from the unusual prevalence of fungous diseases.

The first frost occurred September 23; the first snow-fall occurred November 27, and the first snow-storm, December 5, amounting, in the latter case, to an inch and a half of snow. The severest snow-storm, amounting to 6.5 inches of snow, occurred December 14. Both of these snows disappeared soon.

During eight months of the year the prevailing wind was north-west; during March, September and October, the prevailing direction was north-east; and during June, south-west.

The rainfall during the year amounted to 43.72 inches, which is slightly below the average. The number of days on which an appreciable quantity of water fell was 128. The largest number occurring in one month was 15, in July; the smallest, 7, in August. The largest rainfall for one month was 8.35 inches, in July; the smallest, 1.45 inches, in February.

During the first seven months of the year there were fifty-four days during which the sky was more than seven-tenths overcast by clouds at each observation. During the last five months, when a more detailed system of taking the observation was used, sixty-six days were noticed "cloudy;" twenty cloudy days occurred in September. On twenty-three days during the first seven months, the sky was found less than four-tenths overcast at each observation. April and June had each but one "clear" day; during the last five months there were but twenty-four clear days.

The mean annual temperature was 47.78 degrees, which is nearly 1 degree above the average. The highest temperature for the year was 89 5 degrees, occurring May 9; the lowest, — 9 degrees, occurring February 24. The maximum for 1888 was 94.5 degrees, on July 23; the minimum, — 21.5 degrees, January 23. The absolute range of temperature for 1889 was 98.5 degrees, against 116 for 1888, 115.2 for 1887, and 117 for 1886.

Summary of Meteorological Observations, 1889.

	Temperature, Degrees Fahrenheit.											Relative Humidity, Per Ct.				Precipitation, Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maxi-mum.	Mini-mum.	Range.	Absolute Maxi-mum.	Date.	Absolute Mini-mum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, ...	25.5	35.2	30.2	30.3	49.1	16.1	33.0	58.0	9th	0.5	23d	-	-	-	-	3.29	9th
February, . . .	15.6	25.8	20.8	20.8	37.9	1.9	36.0	42.0	17th	—9.0	24th	-	-	-	-	1.45	18th
March, ...	30.7	42.5	35.3	35.9	49.9	27.6	22.3	63.5	24th	14.0	1st	-	-	-	-	1.46	31st
April, ...	42.0	56.4	45.4	47.4	63.9	32.9	31.0	78.0	19th	25.0	23d	80.7	49.1	71.7	67.2	2.42	1st
May, . . .	53.4	69.2	58.0	59.8	72.6	45.5	27.1	89.5	9th	31.0	4th	83.9	53.6	75.9	71.1	4.15	27th
June, ...	61.6	73.9	64.9	66.4	76.4	53.6	22.8	88.5	30th	38.0	7th	89.2	61.0	84.0	78.0	3.85	11th
July, ...	65.0	75.0	66.2	68.1	74.1	58.5	15.6	86.0	8th	46.5	16th	89.2	66.9	85.7	80.6	8.35	29th–31st
August, ...	58.7	74.0	62.5	64.4	74.7	58.1	16.6	84.0	31st	40.5	29th	94.4	61.2	88.0	81.2	2.69	14th
September, . .	56.3	67.9	59.7	60.9	72.6	46.1	26.5	82.5	6th	34.5	23d	92.0	67.6	84.7	81.4	2.90	17th–19th
October, . .	39.8	53.2	44.0	45.2	60.8	32.7	28.1	69.5	1st	21.0	24th	-	-	-	-	4.10	27th
November, . .	37.0	45.8	39.8	40.6	51.1	24.1	27.0	62.5	3d	14.5	17th	-	-	-	-	6.21	27th–28th
December, . .	29.6	38.9	32.8	33.5	48.9	11.1	37.8	64.0	25th	3.5	4th	-	-	-	-	2.85	8th–9th
Sums, . .	515.2	657.8	559.6	573.3	732.0	408.2	323.8	868.0	-	260.0	-	529.4	359.4	490.0	459.5	43.72	-
Means, . . .	42.94	54.82	46.63	47.78	61.00	34.02	20.98	72.33	-	21.67	-	88.23	59.90	81.67	76.58	3.64	-

Miscellaneous Phenomena, — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Solar Halos.	Lunar Halos.
January, .	4, 5, 13, 15, 26,	20, 21, 27, 28,	5, 6, 7, 9, 16, 17,	–	–	15.
February, .	11,	6, 8, 9, 11, 12, 18, 27.	5, 16, 17,	–	–	–
March, .	1, 13, 15,	31,	4, 5, 6, 16, 17, 28, 29.	28,	–	–
April, . .	7, 10, 11, 15, 23,	1,	1, 3, 20, 25, 26, 27, 28.	20,	–	11, 15, 16.
May, . .	4, 29,	–	10, 11, 13, 14, 20, 21, 25, 26, 27, 30, 31.	10, 14, 25,	–	–
June, . .	7,	–	1, 2, 4, 6, 8, 10, 11, 12, 15, 17, 22, 26.	10, 11, 15,	3,	–
July, . .	–	–	2, 3, 4, 8, 9, 10, 11, 14, 15, 20, 27, 29, 30, 31.	7, 8, 29, 30,	–	–
August, .	–	–	1, 3, 5, 9, 13, 14, 15,	3, 14,	–	–
September, .	23,	–	11, 12, 13, 17, 18, 19, 20, 25, 26, 30.	17,	–	–
October, .	3, 5, 8, 9, 11, 12, 16, 17, 19, 22, 24.	–	1, 6, 7, 10, 12, 13, 20, 21, 22, 26, 27, 28, 29, 31.	–	–	–
November, .	4, 11, 16, 17, 18,	–	2, 3, 9, 10, 11, 13, 19, 20, 21, 22, 23, 27, 28.	–	–	1, 8.
December, .	5, 10, 22, 24, 29, 31.	5, 14,	8, 9, 10, 11, 18, 19, 22, 24, 29.	–	–	–

RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter, beginning with the year 1836.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1836–37, . .	25.396	1837, . . .	69.130
1837–38, . .	26.386	1838, . . .	69.550
1838–39, . .	25.950	1839, . . .	70.180
1839–40, . .	20.626	1840, . . .	68.770
1840–41, . .	23.146	1841, . . .	69.230
1841–42, . .	28.516	1842, . . .	68.210
1842–43, . .	23.460	1843, . . .	67.950
1843–44, . .	21.320	1844, . . .	67.260
1844–45, . .	25.550	1845, . . .	70.120
1845–46, . .	22.140	1846, . . .	68.406
1846–47, . .	25.176	1847, . . .	68.806
1847–48, . .	28.966	1848, . . .	69.210
1848–49, . .	23.026	1849, . . .	69.210
1849–50, . .	27.570	1850, . . .	68.820
1850–51, . .	25.040	1851, . . .	66.640
1851–52, . .	21.620	1852, . . .	66.830
1852–53, . .	27.940	1853, . . .	67.846
1853–54, . .	23.670	1854, . . .	69.856
1854–55, . .	23.126	1855, . . .	67.146
1855–56, . .	20.820	1856, . . .	69.225
1856–57, . .	22.720	1857, . . .	67.240
1857–58, . .	26.956	1858, . . .	67.930
1858–59, . .	24.746	1859, . . .	65.650
1859–60, . .	24.790	1860, . . .	66.540
1860–61, . .	24.510	1861, . . .	66.870
1861–62, . .	24.470	1862, . . .	66.490
1862–63, . .	27.640	1863, . . .	66.656
1863–64, . .	26.060	1864, . . .	69.336
1864–65, . .	21.310	1865, . . .	68.946
1865–66, . .	25.676	1866, . . .	67.400
1866–67, . .	25.276	1867, . . .	67.920

Record of Temperature, etc. — Concluded.

December, January, February.		June, July, August.	
	Degrees F.		Degrees F.
1867–68, . .	20.350	1868, . . .	69.700
1868–69, . .	26.290	1869, . . .	66.890
1869–70, . .	27.866	1870, . . .	71.700
1870–71, . .	26.666	1871, . . .	67.810
1871–72, . .	24.630	1872, . . .	70.790
1872–73, . .	21.350	1873, . . .	68.596
1873–74, . .	27.286	1874, . . .	66.306
1874–75, . .	21.180	1875, . . .	68.026
1875–76, . .	28.156	1876, . . .	71.780
1876–77, . .	23.510	1877, . . .	70.080
1877–78, . .	28.506	1878, . . .	68.896
1878–79, . .	24.290	1879, . . .	68.150
1879–80, . .	30 506	1880, . . .	69.286
1880-81, . .	21.856	1881, . . .	67.966
1881–82, . .	29.256	1882, . . .	69.866
1882-83, . .	24.220	1883, . . .	68.840
1883–84, . .	26.506	1884, . . .	68.960
1884–85, . .	22.630	1885, . . .	66.740
1885–86, . .	24.846	1886, . . .	66.100
1886–87, . .	22.146	1887, . . .	68.100
1887–88, . .	20.827	1888, . . .	67.893
1888–89, . .	27.170	1889, . . .	66.300

C. A. GOESSMANN,
Director.

JAMES P. LYNDE, *Treasurer, in account with* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

1889.	RECEIVED.		1889.	EXPENDED.	
	From State Treasurer,	$10,000 00		Transferred to Hatch funds,	$705 33
	Dr. C. A. Goessmann, director, receipts at station,	991 75		Salaries,	5,057 52
	Dr. C. A. Goessmann, director, fees for certificates of analysis of commercial fertilizers,	1,530 00		Laboratory supplies,	927 48
				Printing and postage,	509 40
				Office expenses,	126 53
				Farmer and labor,	2,600 92
				Farm supplies,	610 72
				Stock,	363 52
				Feed,	354 02
				Miscellaneous expenses,	598 37
				Construction and repairs,	464 64
				Expenses Board of Control,	188 30
				Cash in bank,	15 00
		$12,521 75			$12,521 75

Examined, compared with the vouchers, found correct and approved. WM. R. SESSIONS, *Auditor.*

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